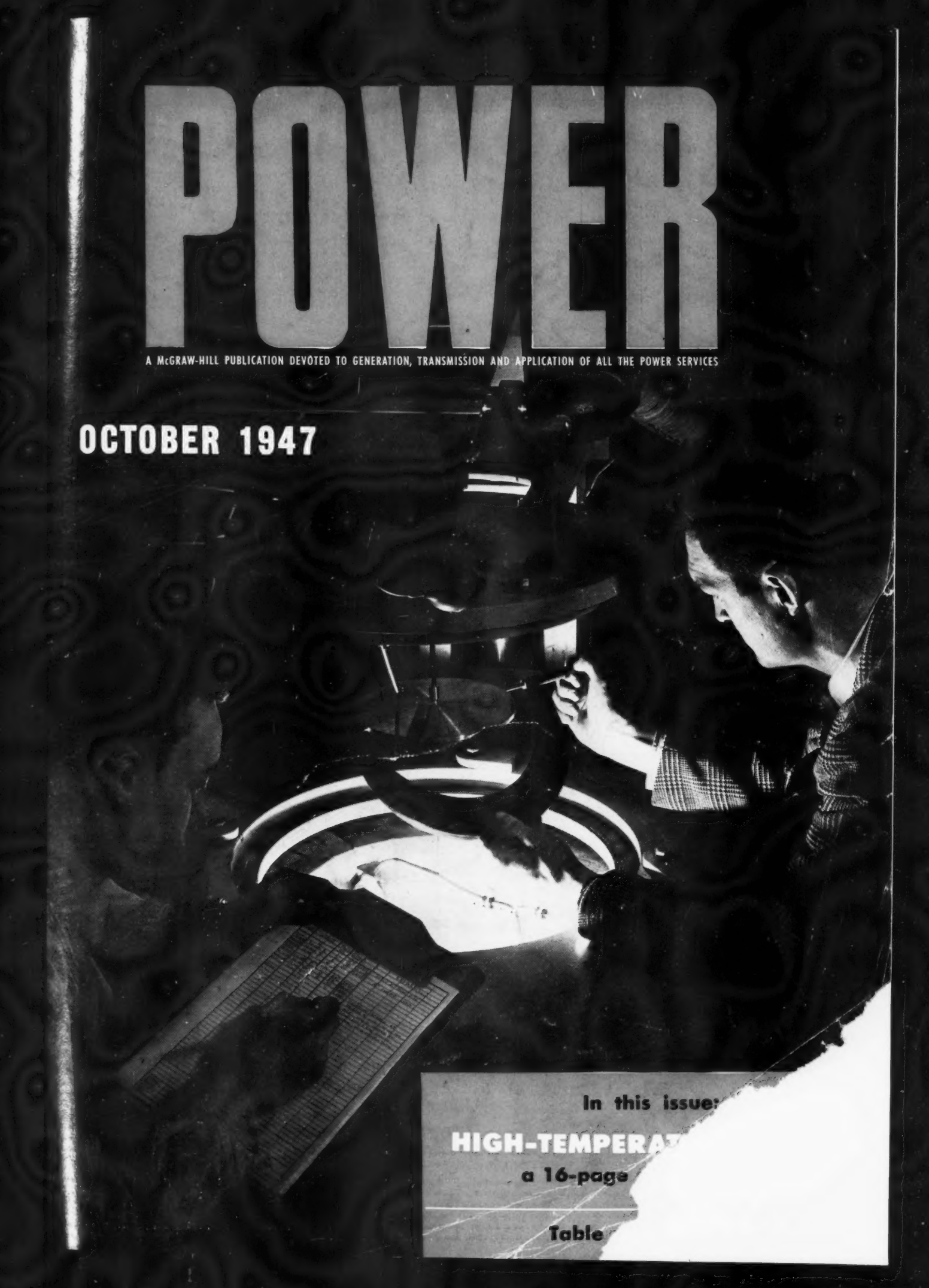
POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES

OCTOBER 1947



In this issue:

HIGH-TEMPERA

a 16-page

Table

Scores greatest triumph—*in a selected field*—on a hard going, heavy course.

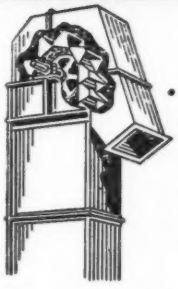
We picked the cream of abrasion resistant alloys—made discs of them—*carefully weighed them*—keyed them on a shaft—*churned them thru a mixture of sharp sand, emery, metal filings and other slurries for hours*—removed them —*carefully weighed them again*—calculated the loss due to abrasive action.

We knew Ashcolite would win, but not by such a wide margin. A large chemical company learned this the hard way; they tried them all. You can benefit the easy way.

When abrasion is the problem—Ashcolite is the metal. We make Ashcolite Pipe, Ashcolite fittings and use Ashcolite in Hydroseal Materials Handling Pumps, etc., etc.
The Allen-Sherman-Hoff Co., 227 S. 15th St., Phila. 2, Pa.

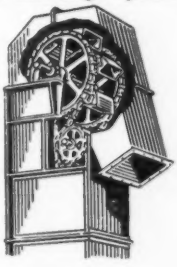
...ry," "The Engineer Review," "The Engineer," "The Stationary Engineer"), October, 1947, Vol. 91, No. 10. Published monthly ...ing Company, Inc. Publication office, 99-129 N. Broadway, Albany 1, N.Y. Editorial and executive offices, 330 W. 42d ... 1936, at Albany, N.Y., under the act of March 3, 1879. Printed in U.S.A. Allow at least 10 days for change of addres... Director of Circulation, Power, 330 W. 42nd St., New York 18, N.Y. Subscription rates, U.S. and U.S. possessions, ...er one year, $9 for two years. Pan American countries, $10 for one year, $16 for two years. All other countries ...pany connection on all subscription orders.

Move materials UP or DOWN Efficiently..the LINK-BELT Way



...by Continuous Bucket Elevator

This type is used where higher capacity at slower speed is desired or where the material is friable. It consists usually of steel buckets mounted on either a chain or belt. Material is fed directly into the buckets at the foot of the elevator and discharged over a head wheel onto the proceeding buckets, whose front and projecting sides form a chute, thereby directing the material into a fixed discharge spout.



...by Perfect Discharge Bucket Elevator

which operates at slower speeds and is used where materials will not readily discharge at centrifugal speeds. Malleable iron or steel buckets are mounted between two strands of chain. Material is fed directly into buckets at the foot of the elevator or scooped up in the boot and discharged over a snubbed head wheel which inverts the position of the buckets over the discharge chute.

...by Centrifugal Discharge Bucket Elevator

which is used for most products. It consists of either malleable iron or steel buckets mounted on either a chain or belt. The material is fed either directly into the buckets at the foot of the elevator or scooped up in the boot and is discharged over the head wheel by centrifugal action.

...by Bulk-Flo

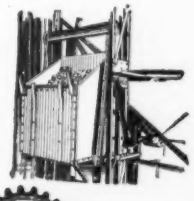
which is used where mass conveying is possible. It consists of malleable iron or steel flights attached to a chain. The material is fed directly into the lower horizontal portion of the casing, thereby eliminating a feeder and is discharged at the opening in the upper portion of the casing, just before the flights reach the head wheel.

...by Rotor Lift

This is a Helicoid (screw) elevator which handles many products that normally can be conveyed by a horizontal screw conveyor. It consists of a vertical screw driven from either the top or bottom, operating in a solid or split casing. The material is fed to the vertical screw by screw feeder near the foot of the lift and is discharged at the top or head end.

...by Skip Hoists

The skip hoist is especially well adapted for making high lifts, elevating abrasive or corrosive materials, and the handling of large lumps, as well as fines. Link-Belt skips are economically applicable to large or small capacities.



LINK-BELT COMPANY

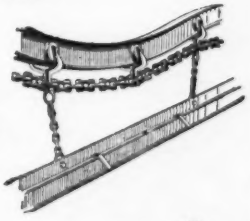
Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities. 10.618-C

★ ★ ★

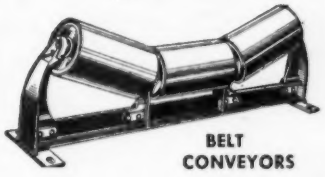
When your plant is "Conveyorized" by LINK-BELT, every unit belongs! Because every unit is selected from the broadest line of conveying machinery, and specified as the most satisfactory type and size for the purpose. Link-Belt manufactures practically every standard type of conveyor and power transmission machinery. Link-Belt "know-how", accumulated from many years of service to industry, is available to aid you in selecting and applying the correct equipment to give the most satisfactory service.

Conveyors by LINK-BELT

meet every need of Industry .... Link-Belt manufactures practically every standard type for handling bulk materials, parts and packaged materials

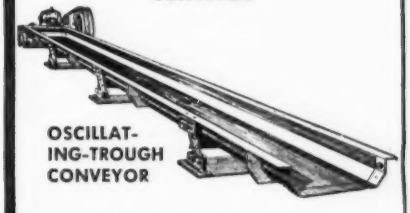


OVERHEAD TROLLEY CONVEYORS

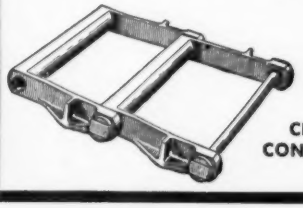


BELT CONVEYORS

SCREW CONVEYOR



OSCILLATING-TROUGH CONVEYOR



CHAIN CONVEYORS

LINK-BELT

Conveyors

A TYPE FOR EVERY KIND OF MATERIALS HANDLING

OUTSTANDING OUTDOORS . . . AS WELL AS IN

One of three oil-and-gas-fired B&W Integral-Furnace Boilers installed outdoors at a Southwest central station. Total steam capacity — 700,000 lb. per hr. at 750 psi, 830F.

Outdoor and Semi-Outdoor Installations of B&W Boilers:

By Industry: Central Station, Refineries, Chemical Plants, Rubber Factories, Manufacturing Plants.

By Locations: Arizona, California, Colorado, Florida, Iowa, Kentucky, Louisiana, New Jersey, New Mexico, New York, Oklahoma, Oregon, Pennsylvania, Texas, Utah, Argentina, Columbia, Cuba, Mexico, Netherland West Indies.

Outdoor and semi-outdoor installations are an old story with B&W Boilers. They have been identified with these types of power plants since their inception over 15 years ago. More than 100 Integral-Furnace, Radiant, and Stirling units with an aggregate steam capacity of 17 million lb. per hr. are now in service or on order. Individual steam capacities range from 25,000 to 500,000 lb. per hr., with pressures up to 1500 psi and temperatures up to 950 F. Fuels include pulverized coal, gas, oil, wood, and industrial refuse.

Installations are located in fifteen different states—North, East, South, and West—and in several countries abroad. Exposed to all kinds of climatic conditions—snow, rain, high winds, temperatures from —30 F to over 100 F—these B&W boiler installations are giving the same high standards of performance and economical operation that have made B&W boilers the leading choice for conventional indoor plants for 80 years.

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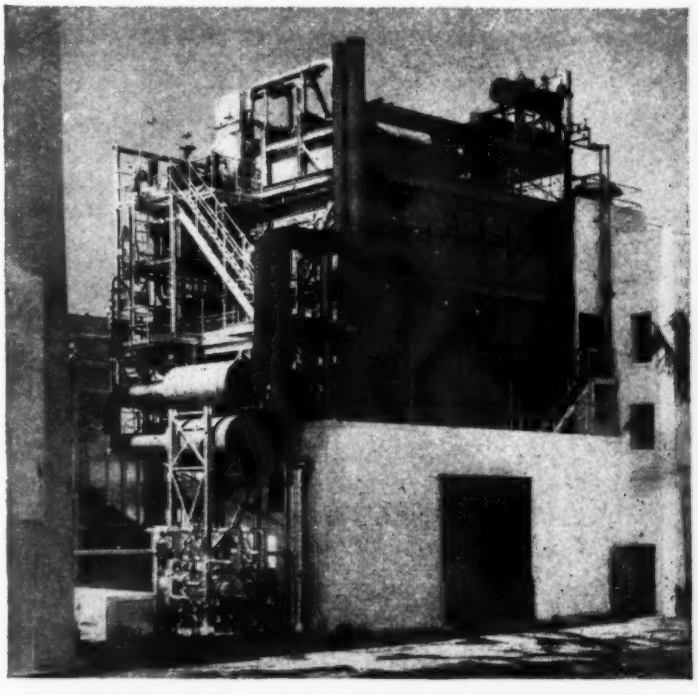
SEP 9 1947
DETROIT

Four 65,000 lb. per hr. B&W Integral-Furnace Boilers installed outdoors at a Utah refinery. They are fired with oil and gas.



A 200,000 lb. per hr. oil-fired B&W Integral-Furnace Boiler installed outdoors at a new central station in Florida. Unit is designed for future use of pulverized-coal.

O-302 T

B&W

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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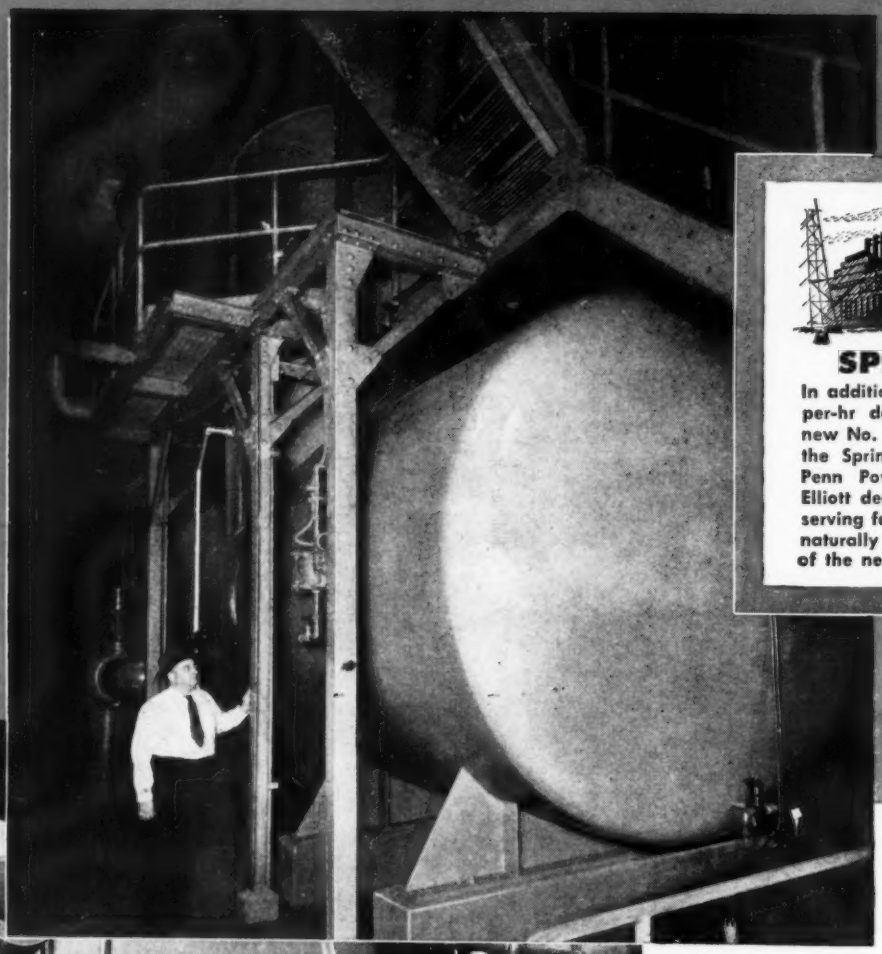
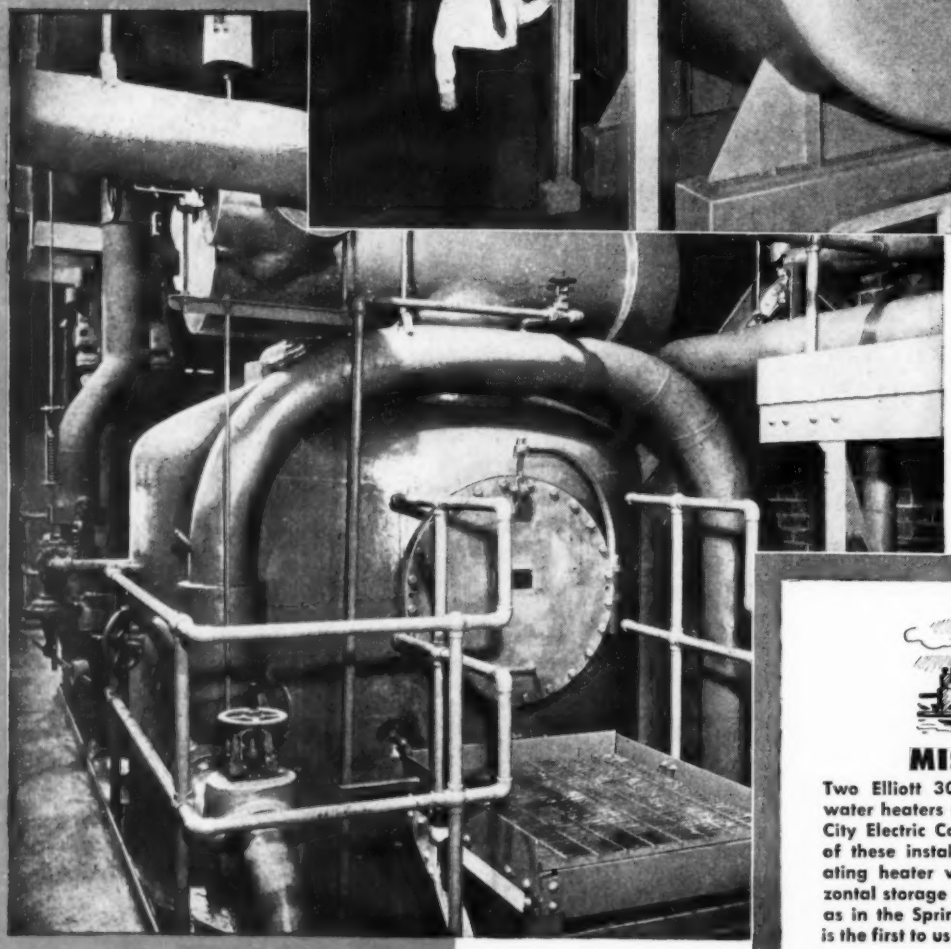


SPRINGDALE

In addition to the 1,000,000-lb-per-hr deaerating heater in its new No. 7 extension, illustrated, the Springdale Station of West Penn Power Company has an Elliott deaerator which has been serving faithfully for 22 years — naturally a factor in the selection of the new deaerating heater.

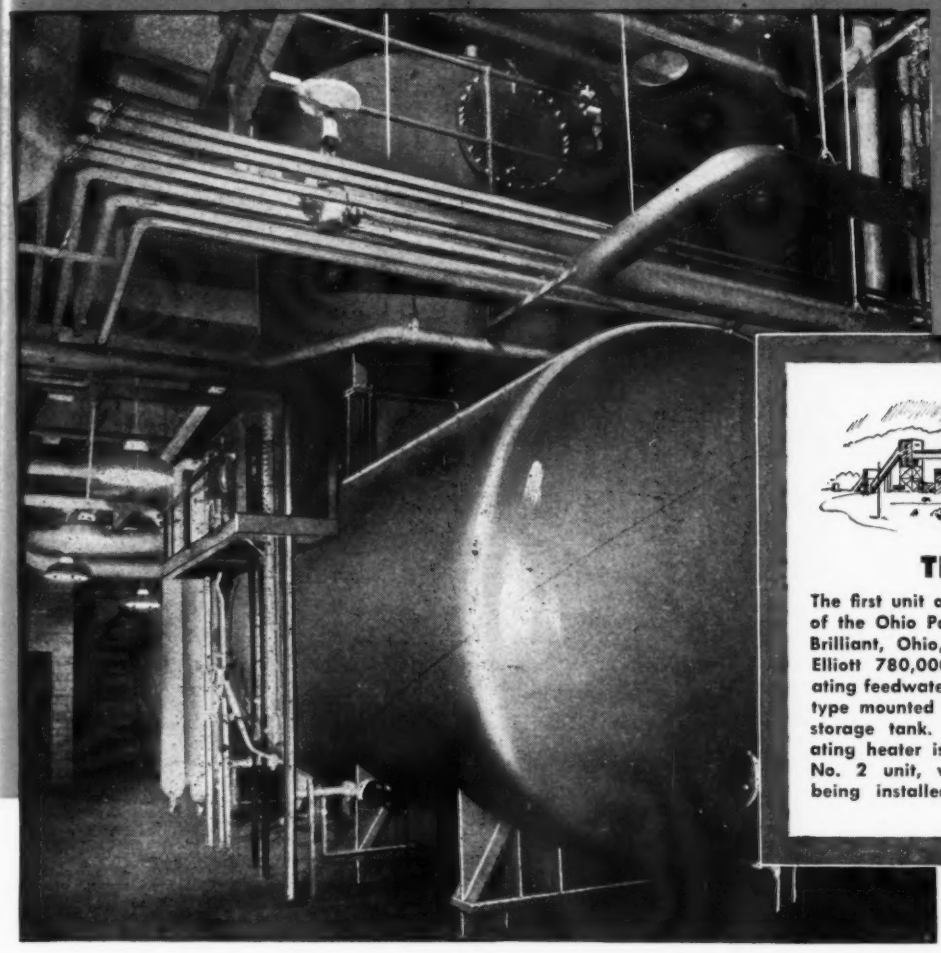


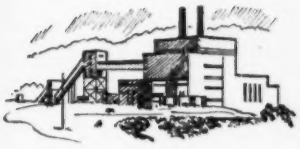
Big, up-t

MISSOURI AVE.

Two Elliott 300,000-lb-per-hr deaerating feedwater heaters serve units 6 and 7 of the Atlantic City Electric Company. The photo, of the newest of these installations, shows the vertical deaerating heater with its vent condenser. The horizontal storage tank is located beneath the heater, as in the Springdale and Tidd units. This station is the first to use steam at a temperature of 1000 F.

Elliott





TIDD

The first unit of this new station of the Ohio Power Company, at Brilliant, Ohio, is served by an Elliott 780,000-lb-per-hr deaerating feedwater heater of vertical type mounted upon a horizontal storage tank. A similar deaerating heater is on order for the No. 2 unit, which is currently being installed.

-to-date stations agree on Deaerating Heaters *by* Elliott

It is a grave responsibility to mount guard against corrosion over the millions of dollars worth of equipment represented in plants such as those shown here. It is a responsibility which is not placed lightly.

In the three fine stations represented here, this vital task is entrusted to Elliott deaerating feedwater heaters. These units deliver in the required quantity, water free of dissolved oxygen, heated to saturated steam temperatures. The ability of these units to serve satisfactorily is based firmly upon sound experience gained through years of application, and stemming from Elliott Company's pioneering in the early history of deaeration.

Whether for an important utility, or for a comparatively small industrial power plant, Elliott enginers are prepared to evaluate attendant conditions and to supply deaerating heater capacity conforming to installation requirements. Let us discuss it.

Deaerating heater bulletin on request.

N-990

OMPANY

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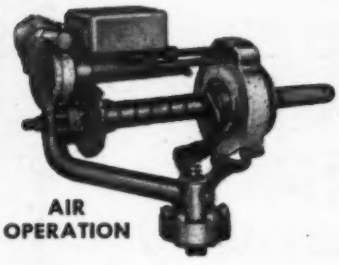
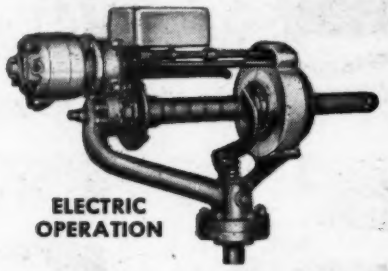
TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

Efficient BOILER OPERATION

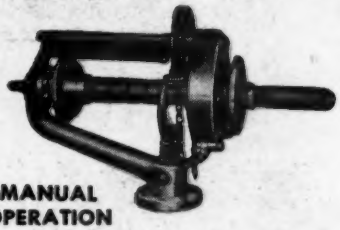
DIAMOND Model IR Short Retracting Soot Blowers



AIR OPERATION



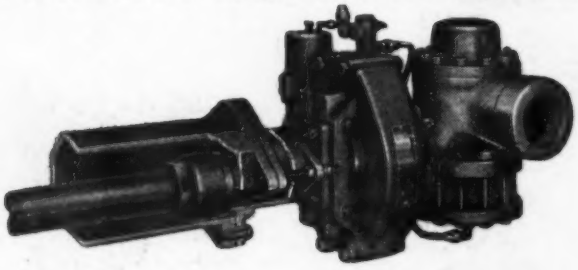
ELECTRIC OPERATION



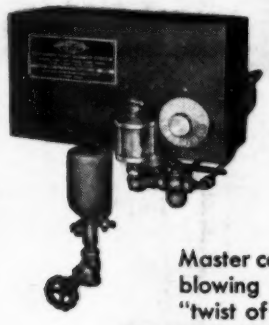
MANUAL OPERATION

For cleaning either furnace walls or boiler heating surfaces where gas temperatures exceed limit for permanently installed units. Equally applicable to compressed air or steam as cleaning medium. Important advantages include: positive poppet type valve, 12″ travel, no lubrication, 360° blowing without additional advance of nozzle, simple, etc.

DIAMOND Model A2E Automatic Air Puff Soot Blowers

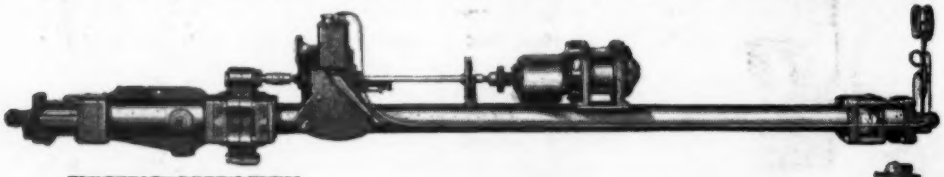


Cleans heating surfaces by series of compressed air puffs delivered through standard multiple nozzle blowing element. Spreading cleaning cycle over longer time permits smaller compressor and receiver . . . also eliminates stack discharge nuisance.

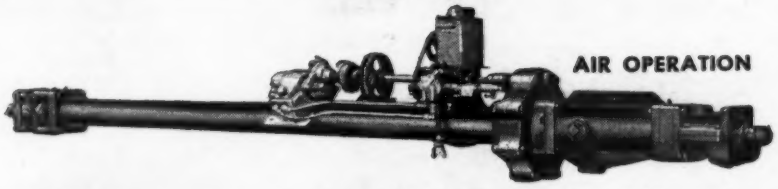


Master controller automatically controls blowing time and sequence. Just a "twist of the wrist" to open valve . . . controller does rest. Automatic control assures correct boiler cleaning.

DIAMOND Telescopic Retracting Soot Blowers



ELECTRIC OPERATION



AIR OPERATION

Used where insufficient clear space outside boiler will not permit installation of Model IK retracting blower for cleaning surfaces inaccessible to short retracting blower and where gas temperatures are too hot for permanently installed units. Standard 16′ travel requires approximately 12′ clear space outside boiler; special travels up to 20′. Uses air or steam as cleaning medium.

DIAMOND POWER SPECIALTY CORP.

REQUIRES THE SELECTION OF SOOT BLOWERS THAT EXACTLY SUIT YOUR INDIVIDUAL REQUIREMENTS

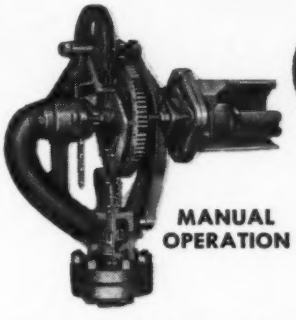
DIAMOND Model IK Long Retracting Soot Blowers

AIR OPERATION

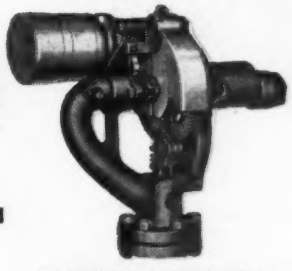
ELECTRIC OPERATION

Use steam or air to clean surfaces inaccessible to Model IR short retracting type and where gas temperatures are too hot for permanently installed soot blowers. Three standard sizes have travels of 10′, 12′ and 16′; also special travels up to 20′. Clear space outside setting approximately 4′ plus travel.

DIAMOND Model G9B Soot Blower

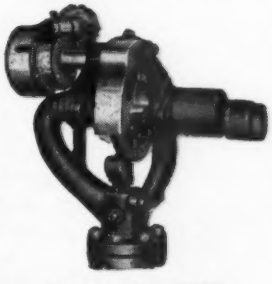


MANUAL OPERATION



ELECTRIC OPERATION

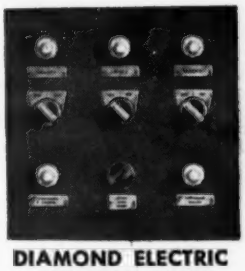
Uses steam as cleaning medium through multiple nozzle blowing element permanently installed inside setting. "Automatic Valved" requiring only one continuous operation to open and close valve in head and simultaneously rotate element. Other important features: adjustable pressure control unit, clockwise or counterclockwise rotation, 360° blowing arc, etc.



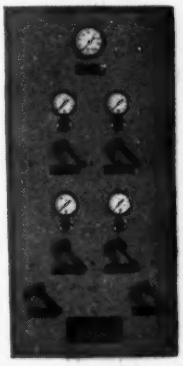
AIR OPERATION

FOR AUTOMATIC SEQUENTIAL SOOT BLOWING

Correct cleaning is always assured and labor is saved. "Human element" is eliminated as operator normally only presses start button or opens master control valve. Each blower unit must operate in correct sequence and at right speed every time. No blower can be overlooked or incorrectly operated. Labor is saved because no need for attendant to warm up piping, drain it, and then operate each blower unit manually. Blower grouping can sectionalize heating surface into zones to maintain normal heat absorption by different frequency of group operation. System can be completely air or electric operated and controlled . . . or combination of both.



DIAMOND ELECTRIC CONTROL PANEL



DIAMOND AIR CONTROL PANEL

DIAMOND SOOT BLOWERS . . .
the Most Complete Line

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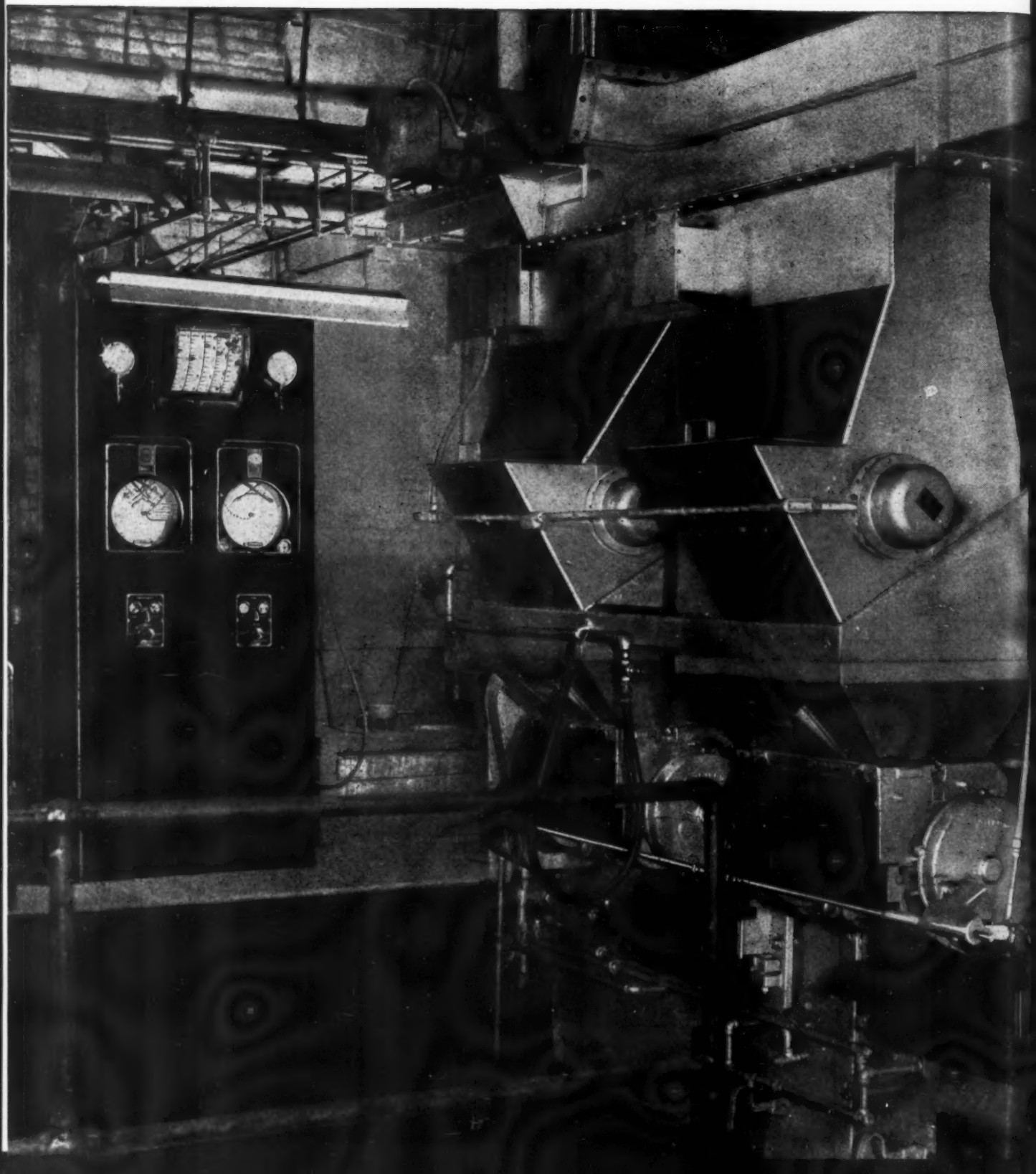
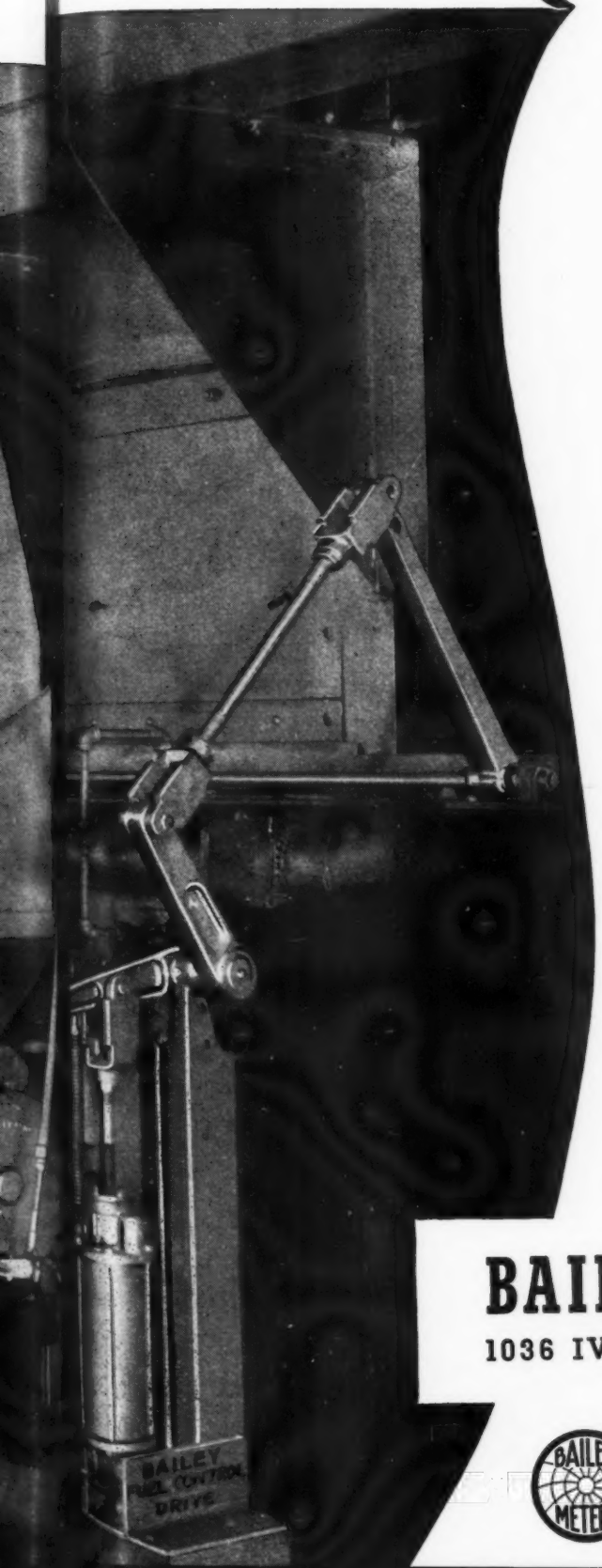
installations like



this... cut power costs



★ This picture is worth a second look. It shows how Engineers are conserving fuel and reducing power costs at International Braid Co., Providence, R. I.

This is an on-the-job picture of Bailey Co-ordinated Boiler Control—the type of control you should now be using to get the most steam for the fewest fuel dollars. With this control you will increase operating safety and improve continuity of service.

The Bailey control drive, shown in the right foreground of this picture, is connected to the coal feed lever of the spreader stoker and regulates the lever in accordance with steam pressure. Similar control drives regulate forced and induced draft dampers to maintain steam pressure, combustion efficiency and furnace draft. In this installation, combustion and feed water controls are co-ordinated to assure optimum boiler operation.

The user reports that prior to installation, it was common to have wide pressure swings during the day. A decided improvement was obtained when this control was installed.

Like all Bailey co-ordinated Boiler Control installations, this one was designed and engineered to the specific job—the same as yours will be. Bailey engineers will work directly with you and your engineers in the application of the meters and controls required by your boilers.

Why not discuss your power problems with a Bailey Engineer? You may be surprised, as many others have, to discover how quickly Bailey Co-ordinated Boiler control will pay for itself in fuel saved. Records show that in many cases installation costs have been returned in less than one year.

A-102

BAILEY METER COMPANY

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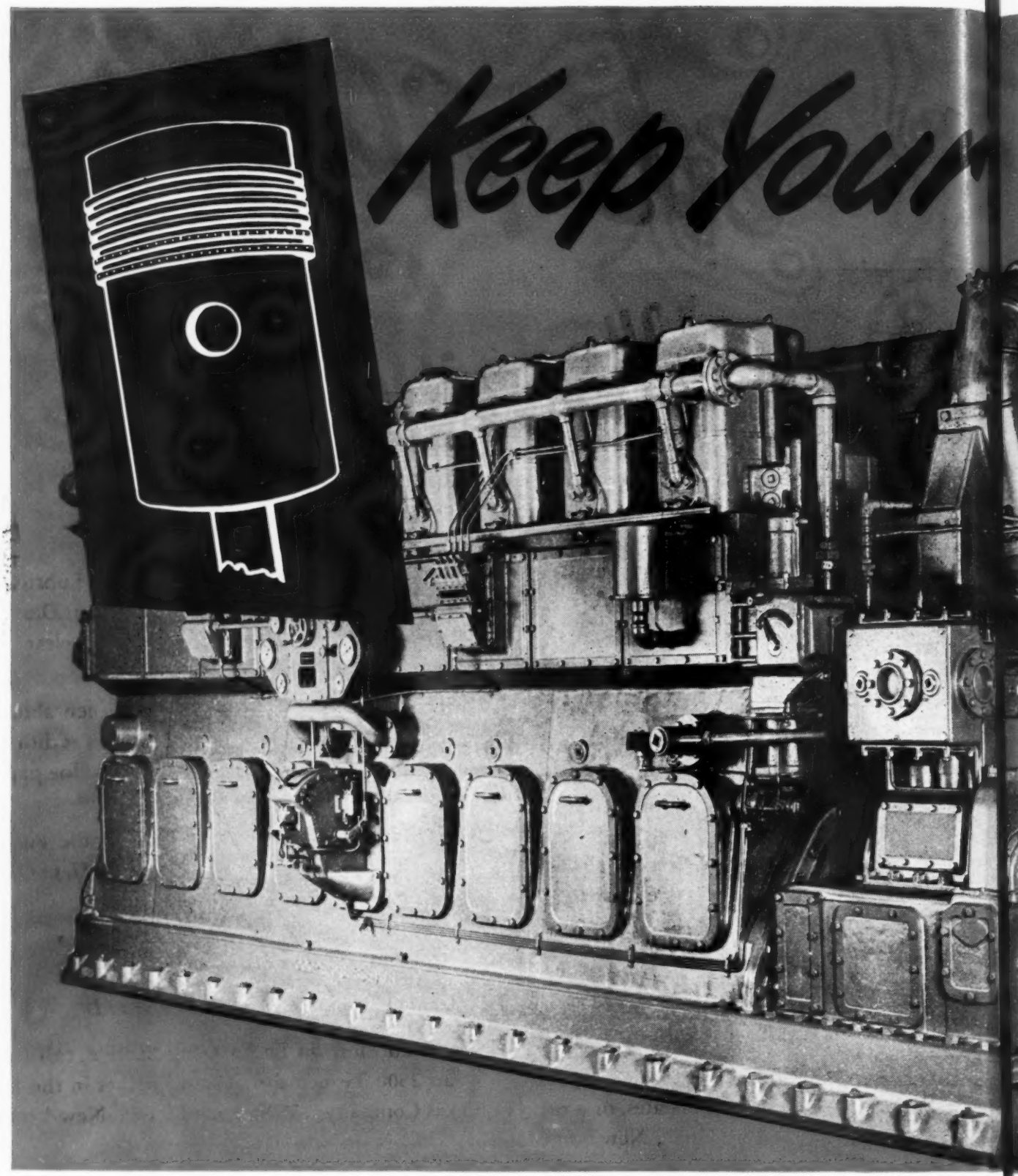
Controls for Steam Plants

BAILEY METERS

COMBUSTION • FEED WATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS



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every Sunday night.
See newspaper for
time and station.

TEXACO

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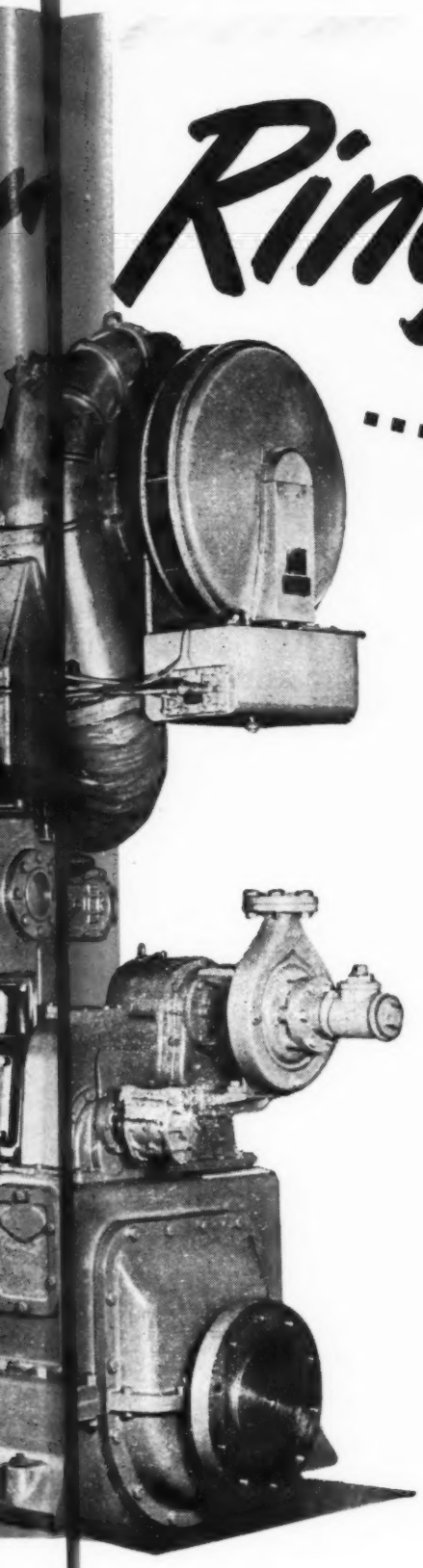


Rings Free

...YOUR FUEL COSTS LOW

DON'T LET stuck rings stick you with high fuel costs. Lubricate with *Texaco Ursa Oils*—your best bet to keep your Diesels clean and powerful . . . rings free . . . valves active . . . ports clear . . . *fuel costs low!*

Texaco Ursa Oils effectively resist oxidation . . . hence their ability to prevent sludge, varnish and hard carbon formations. In addition, they keep wear at a minimum . . . assure longer life for engine parts . . . reduce maintenance costs.

Texaco makes *Ursa Oils* in a complete series to handle every requirement, and—*you can't buy better Diesel lubrication! Ursa Oils* are approved by all leading Diesel manufacturers and—

More stationary Diesel horsepower and more Diesel locomotives in the U. S. are lubricated with Texaco Ursa Oils than with any other brand.

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2500 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

URSA OILS

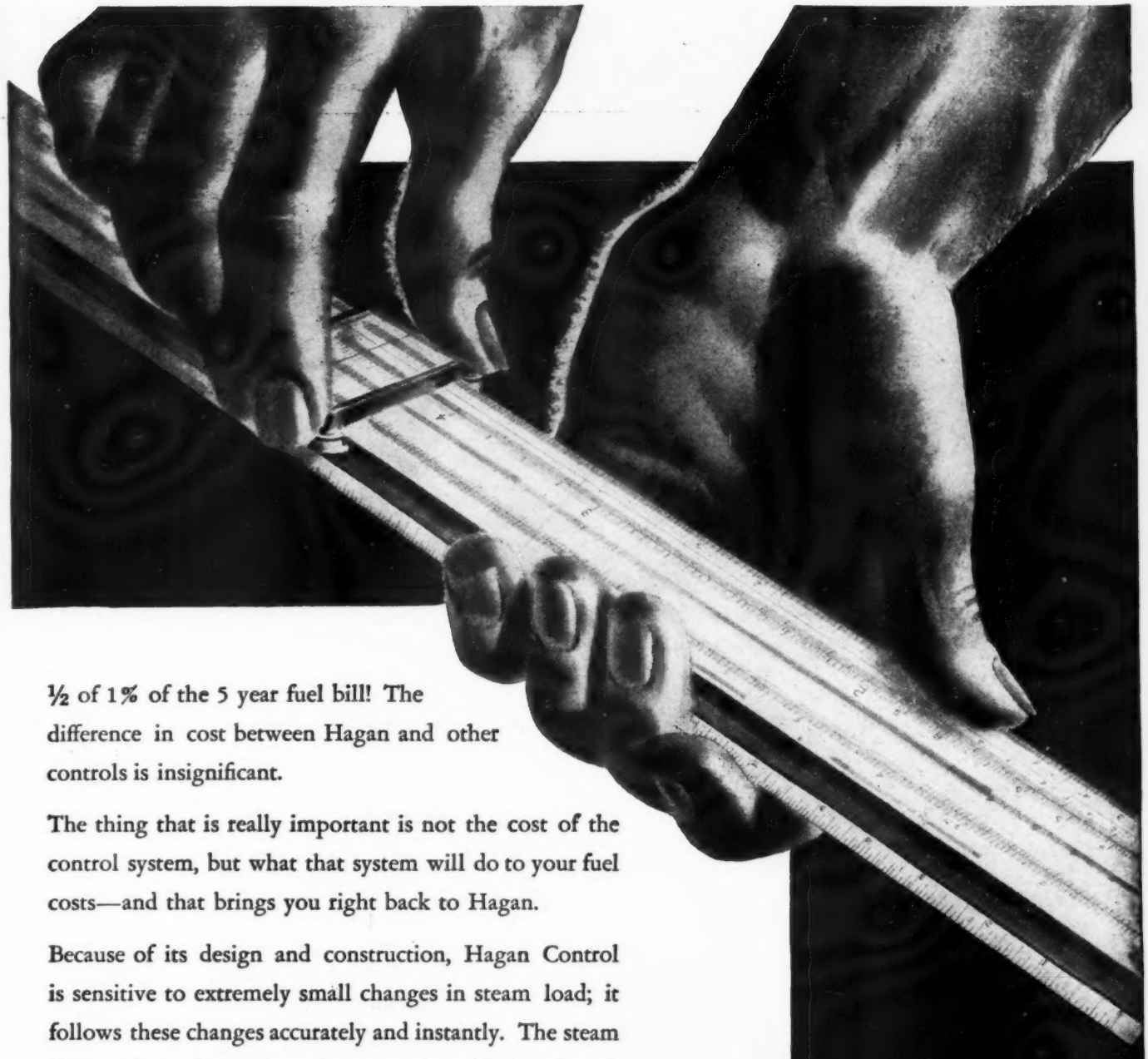
FOR ALL DIESEL ENGINES

Diet Control for a million-dollar appetite

The next time you consider a boiler installation give your slide rule a bit of exercise by figuring out just how many dollars' worth of fuel that boiler will consume during its useful life. You will find that even a moderate sized boiler has a million-dollar appetite.

Take for example a 100,000 lb. / hr. boiler, running 24 hours a day, 300 days a year. Coal consumption will be roughly 5 tons an hour. At $6.00 a ton, your fuel bill will be $720.00 a day, $216,000 a year. Such a boiler will consume a million dollars worth of fuel in less than five years—and five years is only a fraction of the useful life of boiler and control.

The total cost of Hagan Automatic Combustion Control for that boiler would be in the neighborhood of



½ of 1% of the 5 year fuel bill! The difference in cost between Hagan and other controls is insignificant.

The thing that is really important is not the cost of the control system, but what that system will do to your fuel costs—and that brings you right back to Hagan.

Because of its design and construction, Hagan Control is sensitive to extremely small changes in steam load; it follows these changes accurately and instantly. The steam flow-air flow chart of any Hagan-equipped boiler is evidence of the inherent stability of the Hagan system.

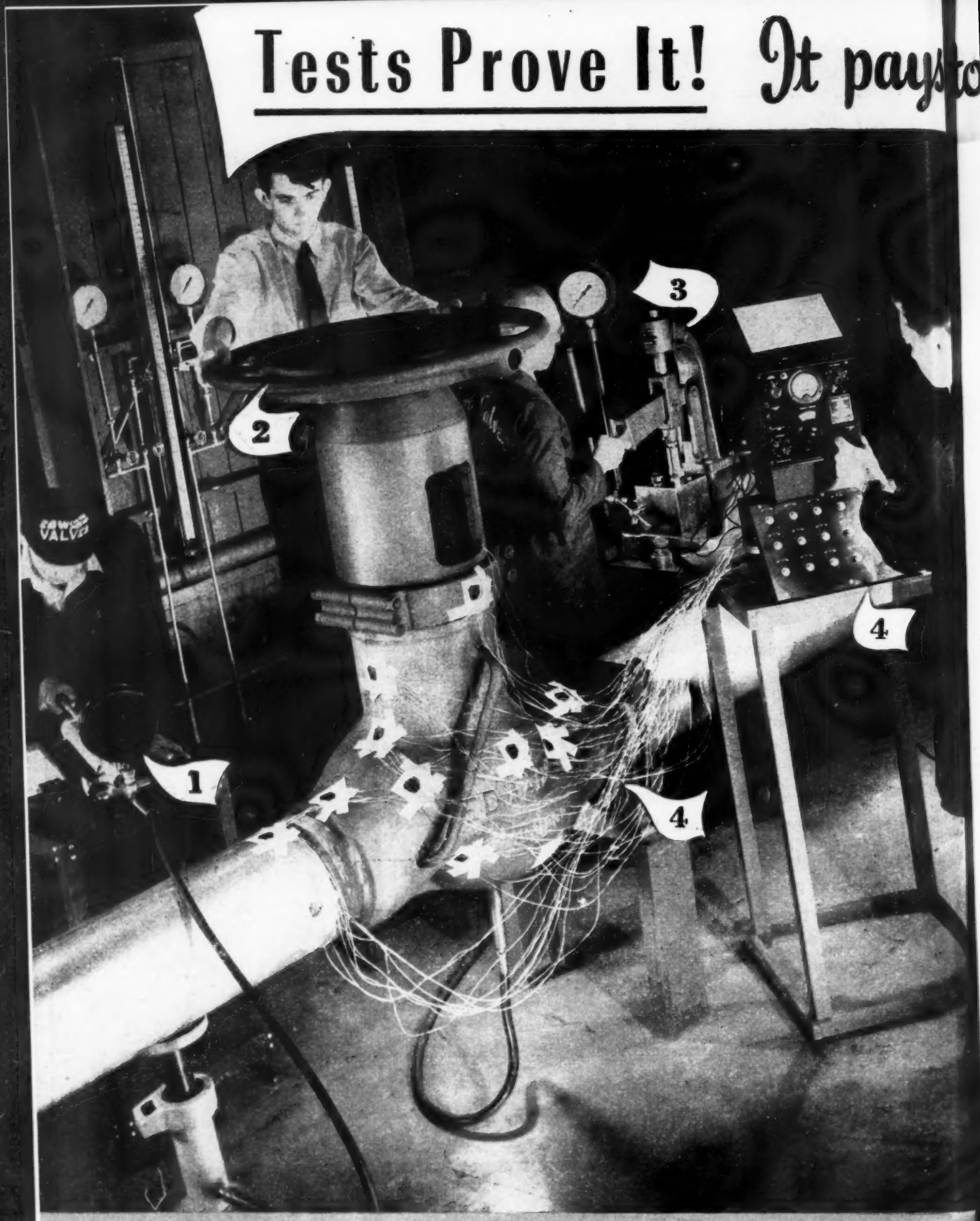
Hagan equipment lasts as long as the boiler—and gives you dependable, trouble-free service as long as it lasts. Our engineers are at your service. Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

Tests Prove It! It pays to



Stress analysis of new valve design in which the three major stresses encountered in service are duplicated and measured.

1. Application of bending load simulating pipe line stresses.
2. Application of load resulting from seating valve with Edward Impactor handwheel.
3. Application of internal line pressure to valve.
4. Measurement of resulting strains with SR-4 strain gage equipment. Measures in millionths of an inch.

Flow testing facilities in background.

ys to specify Edward STEEL VALVES

New Edward Designs Reduce Pressure Loss, Give Up to 30 Per Cent More Flow, Cut Wear-Producing Turbulence, Assure Maximum Strength

Tiny streamers in test half-section model of new Edward globe valve show actual flow conditions. Test is one of many to guide Edward design engineers.

TRIAL AND ERROR is one way to develop valve designs—the old way—slow, inaccurate, uncertain.

THERE'S A BETTER WAY: The Edward pre-test procedure—an orderly, step-by-step, fact-to-fact progress that eliminates guesses and approximations.

IT STARTS with building a valve cross-section using modeling plastics, testing it, changing it, testing again and again until internal contours as near perfect as possible for free flow are developed.

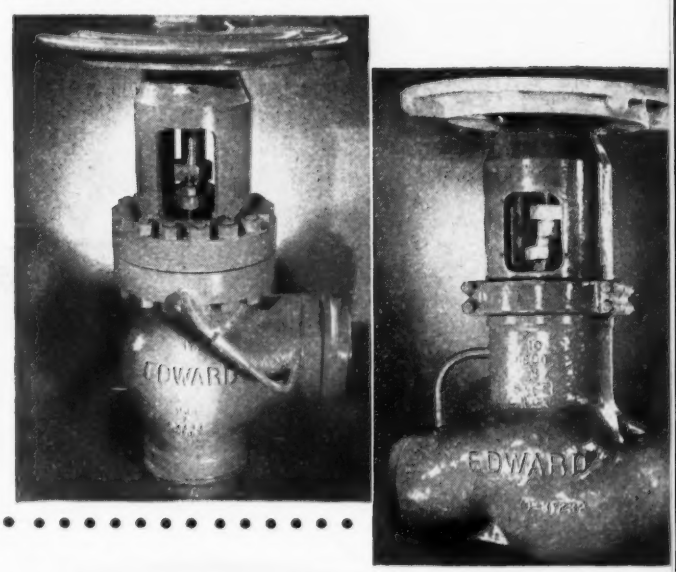
FROM THAT perfected model are made plaster casts of the flow passages, cross-section templates, patterns, and finally steel castings. Actual tests then prove the valve's flow rate and capacity, its freedom from excessive and erosive turbulence. A completely different set of tests prove the valve's structural soundness, its resistance to every strain, its shaping to compensate for distortions of high pressure, high temperature operation.

TO ESTABLISH this procedure Edward developed a whole new range of test equipment, much of it not duplicated anywhere. But it was worth it, for the results are definite and measurable. Typical are these

Body castings for new welding end Edward pressure-sealed valves. Wall shapes and internal contours are the results of years of original flow research. End threads are for shop testing.

SPECIFIC ADVANTAGES

- Up to 30 per cent more flow (*more volume where you need it*).
- Less pressure loss (*smaller piping and valves often possible*).
- Less wear on vital parts (*sharp turns which cause wear-inducing turbulence are eliminated*).
- Safety (*engineered to proved safety factor*).
- Tighter (*built to compensate for distortions of operation*).
- Easier to operate (*because of Edward patented Impactor handwheel and EVal-thrust yoke bushing*).



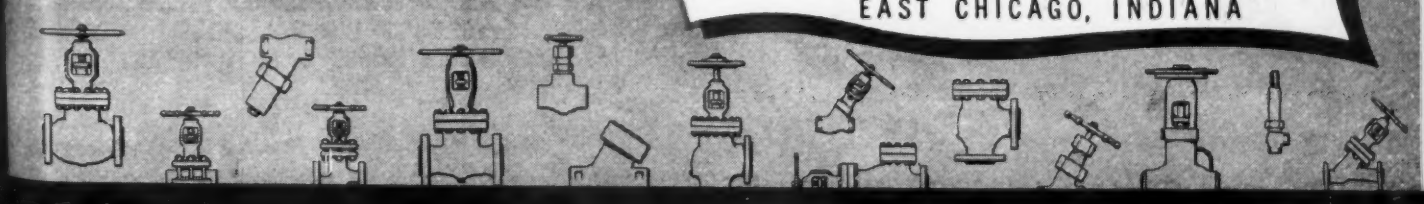
Two of the newer Edward valve designs. Left, 12 in. 1500 lb flanged bonnet angle; right, 10 in. 900 lb pressure sealed globe. Both have patented Impactor handwheel and Edward Equalizer.

DETROIT PUBLIC LIBRARY

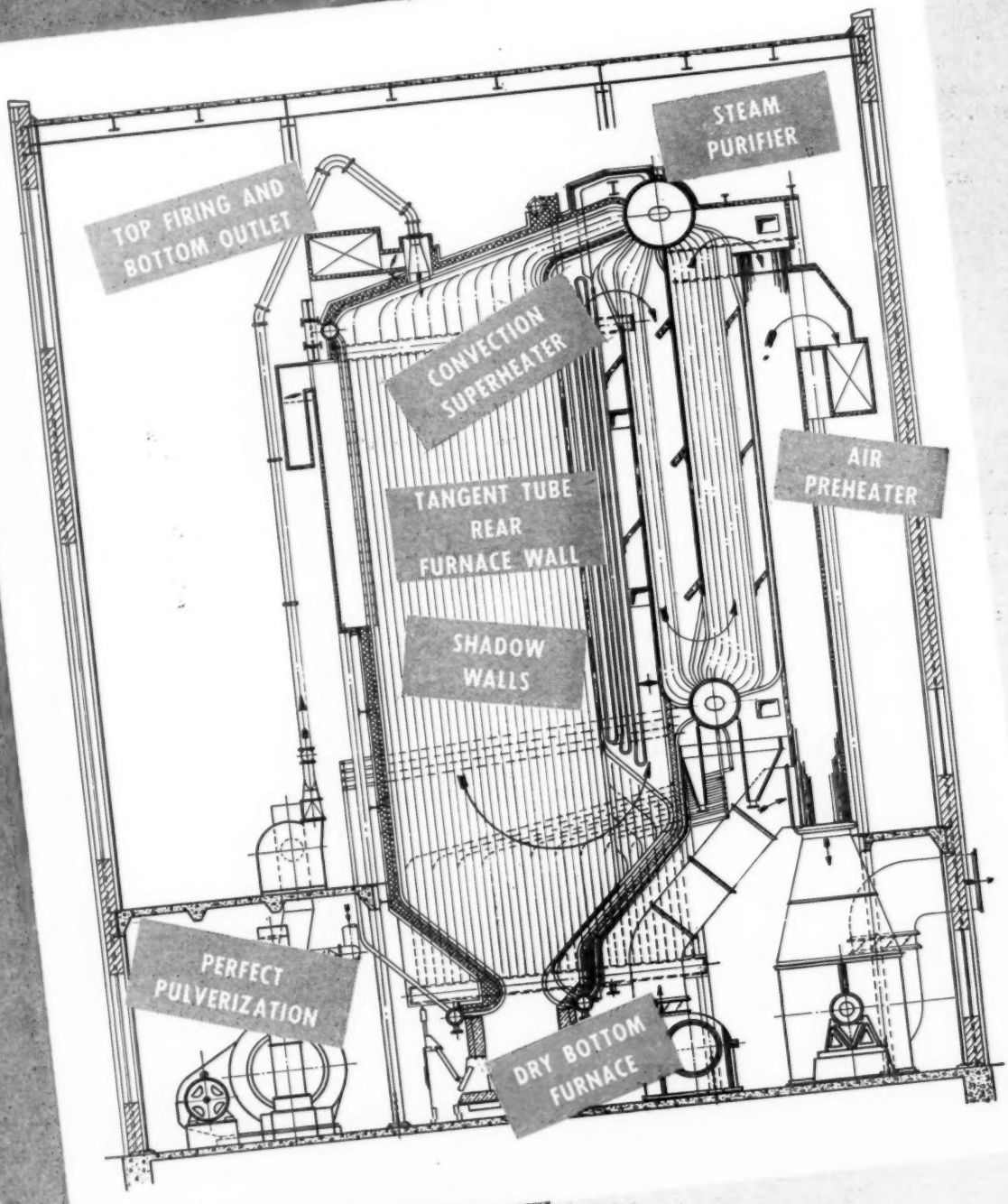
Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA



KVS ENGINEERED



NO. 8 OF A SERIES

See SEPTEMBER "POWER" for description of PREHEATERS

DRY BOTTOM FURNACE

INCREASES Radiant Surface
REDUCES Hopper Maintenance

Tubes forming the dry bottom furnace are a part of the furnace wall enclosure and originate in headers so arranged that water supply is distributed throughout their entire length. The throat formed by these tubes is designed to protect the ash collecting hopper and is sealed against air infiltration.

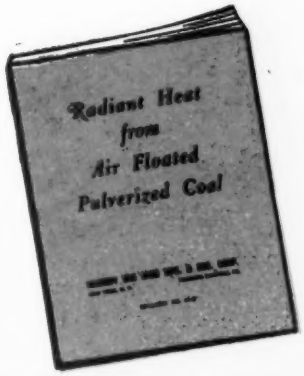
Ash formed by combustion is deposited on the sloping portion and finally deposited in the refractory lined hopper below.

Designed to accommodate the lower heat value, high ash content fuels, the KVS Dry Bottom Furnace assures long operating periods without refractory maintenance.

All other components of KVS Steam Generating Units are engineered to meet specific operating conditions on available fuels in order to assure the maximum in operating efficiency and economy at all boiler ratings.

KVS Steam Generating Equipment has been performance proved over the years. KVS offers a complete service in design, building and erecting complete plants under one responsibility. KVS engineers are available for consultation on your requirements.

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.



KVS
ENGINEERING
SERVICE

KENNEDY-VAN SAUN · QUALITY · SERVICE · Kennedy Products · NEW YORK · USA · MFG. & ENG. CORP.

Kennedy-Van Saun
MANUFACTURING AND ENGINEERING CORPORATION
2 PARK AVENUE • NEW YORK 16, N. Y.
FACTORIES: DANVILLE, PA.
CANADA • ENGLAND • FRANCE • AUSTRALIA

ARMY E NAVY

Get orders in now for . . . Industrial

Stockpiles coal

This versatile, high-speed Tournapull hauls up to 2 tons of coal per trip . . . spreads in shallow, uniform layers . . . compacts coal without damage through cushioning action of big rubber tires. Speeds handling . . . prevents combustion fires . . . saves valuable storage space.

Grades building sites

You'll find this 3.3 yard D Tournapull extremely useful for grading new building sites, building access roads, earth dams and levees, and for general clean up around your plant. Rig is self-loading . . . works alone or in fleets of two or more units where additional capacity is needed.

Levels parking lots

Need more parking space for employees and visitors . . . additional facilities for workers' recreation . . . plant garden program? One man with a D Tournapull can economically handle all leveling . . . make waste land pay off in improved public and industrial relations.

LETOURNEAU LET

See your Le Tourneau Distributor NOW for complete information

NEW D TOURNAPULL

handyman ....

Handles bulk materials

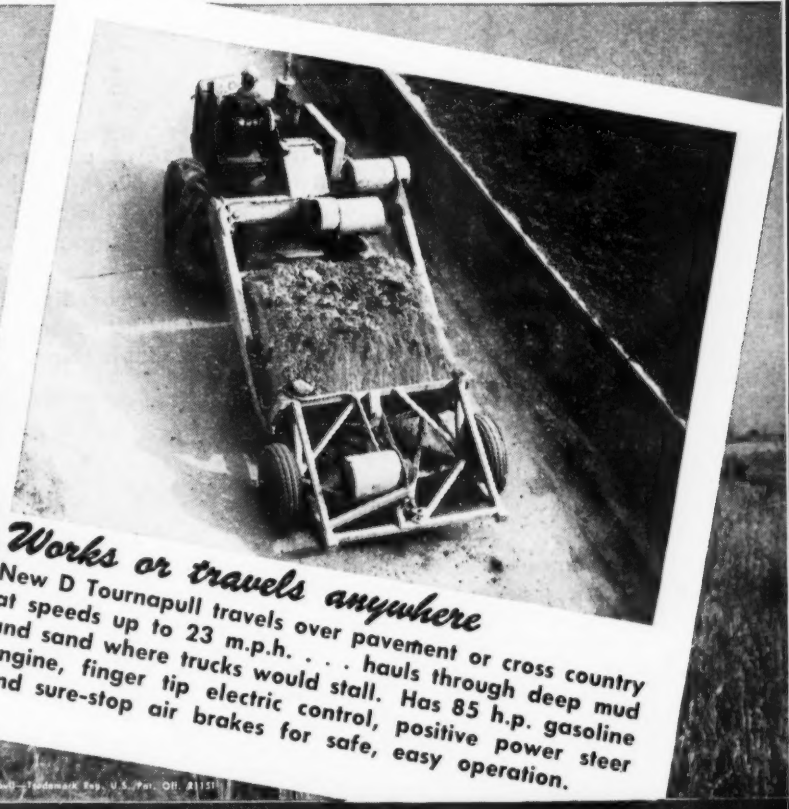
If you have materials handling problems . . . ore, chemicals, fertilizer, crushed stone, waste . . . this handy one-man Tournapull will help you solve them fast and economically. Loads, hauls, piles, spreads . . . dumps from ramp or through grizzly to cars, trucks or conveyors.

Utility railroad tool

Ideal for building new sidings or short spur tracks. One man handles complete excavating job . . . grade, drain and ballast spreading. Also useful as a maintenance tool for cutting down banks . . . cleaning drainage ditches . . . fixing slides and washouts. Crosses tracks at will.

Digs, hauls and spreads gravel

Rig strips gravel from nearby pits . . . hauls to site . . . spreads in smooth compacted layers. Ideal for graveling haul roads, parking lots, driveways and open yard areas. It's a money saver on maintenance work . . . gets more jobs done at less cost per job.



Works or travels anywhere

New D Tournapull travels over pavement or cross country at speeds up to 23 m.p.h. . . . hauls through deep mud and sand where trucks would stall. Has 85 h.p. gasoline engine, finger tip electric control, positive power steer and sure-stop air brakes for safe, easy operation.

Tournapull—Trademark Reg. U.S. Pat. Off. 81131

TOURNEAU PEORIA, ILLINOIS — HIGH-SPEED UTILITY — TOURNAPULLS

"There's an

YARWAY

1 Floatless

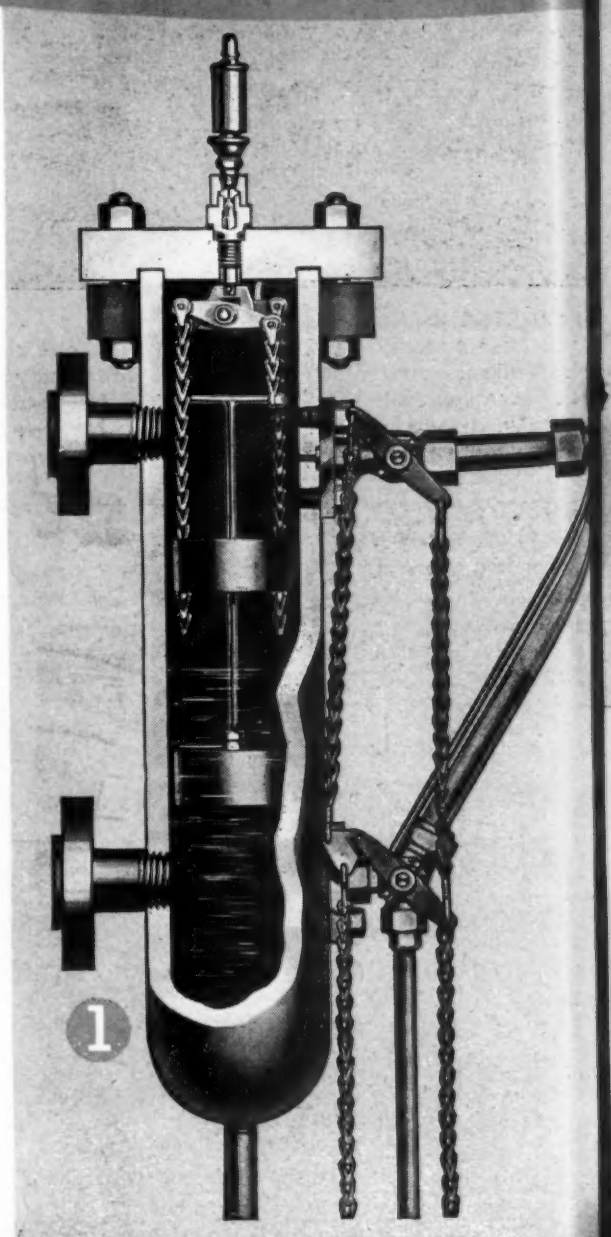
Yarway's Hi-Lo Alarm Water Column has an alarm mechanism that is simple . . . dependable . . . unique. Solid weights operate the whistle alarm. The principle employed is that heavy objects submerged or partly submerged in water are buoyed up by a force equal to the weight of the water they displace. Any dangerous change in water level causes the weights to open or close a needle valve through which steam is admitted to the alarm whistle. The alarm is always dependable . . . the weights can never become waterlogged. Yarway Column shown has Sesure Inclined Gage for pressures up to 400 psi. Flat Glass Gages furnished for pressures to 1500 psi. Ask for Bulletin WG-1811.

2 Remote

Yarway's Remote Water Level Indicator brings overhead boiler water level readings right down to eye level, on the instrument panel or other convenient place, on a brilliantly lighted red and green scale. Indication is *positive* and *instant* because the instrument is operated by the boiler water itself. Shows boiler water level beyond the range of overhead gage, and always indicates high or low—even when full or empty overhead gages look the same. Suitable for all pressures to 1500 psi. Ask for Bulletin WG-1822.

3 Seatless

Yarway's famous Seatless Blow-Off Valve eliminates one of the commonest sources of trouble and expense in boiler blowdown service. *There is no seat* to score, wear and clog with mud, dirt and scale. Balanced sliding nitralloy plunger and straight through flow make operation easy. Today this valve is "standard" in over 12,000 boiler plants. Suitable for all pressures up to 2500 psi. Ask for Bulletin B-424 (to 400 psi), Bulletin B-432 for higher pressures.

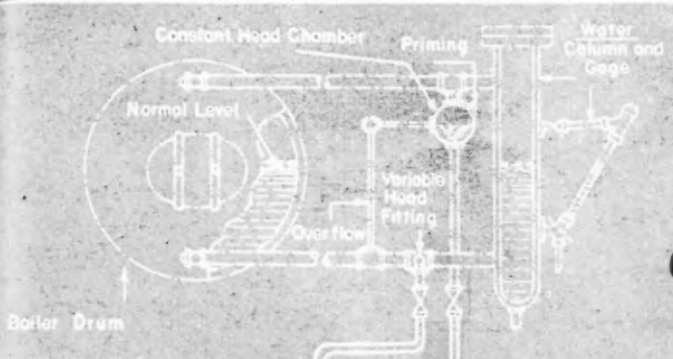


YARWAY

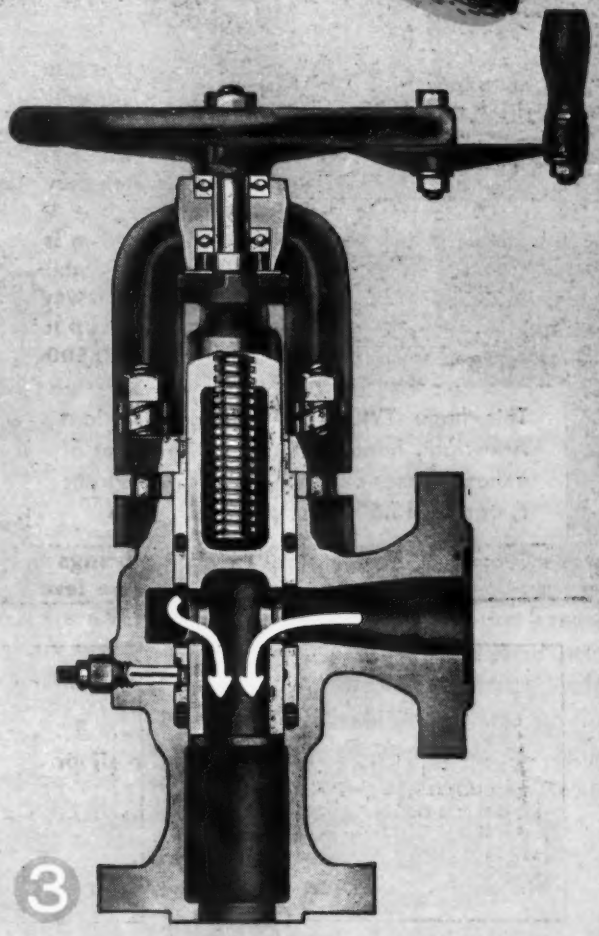
YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

Engineering Reason"

BOILER TRIM



2

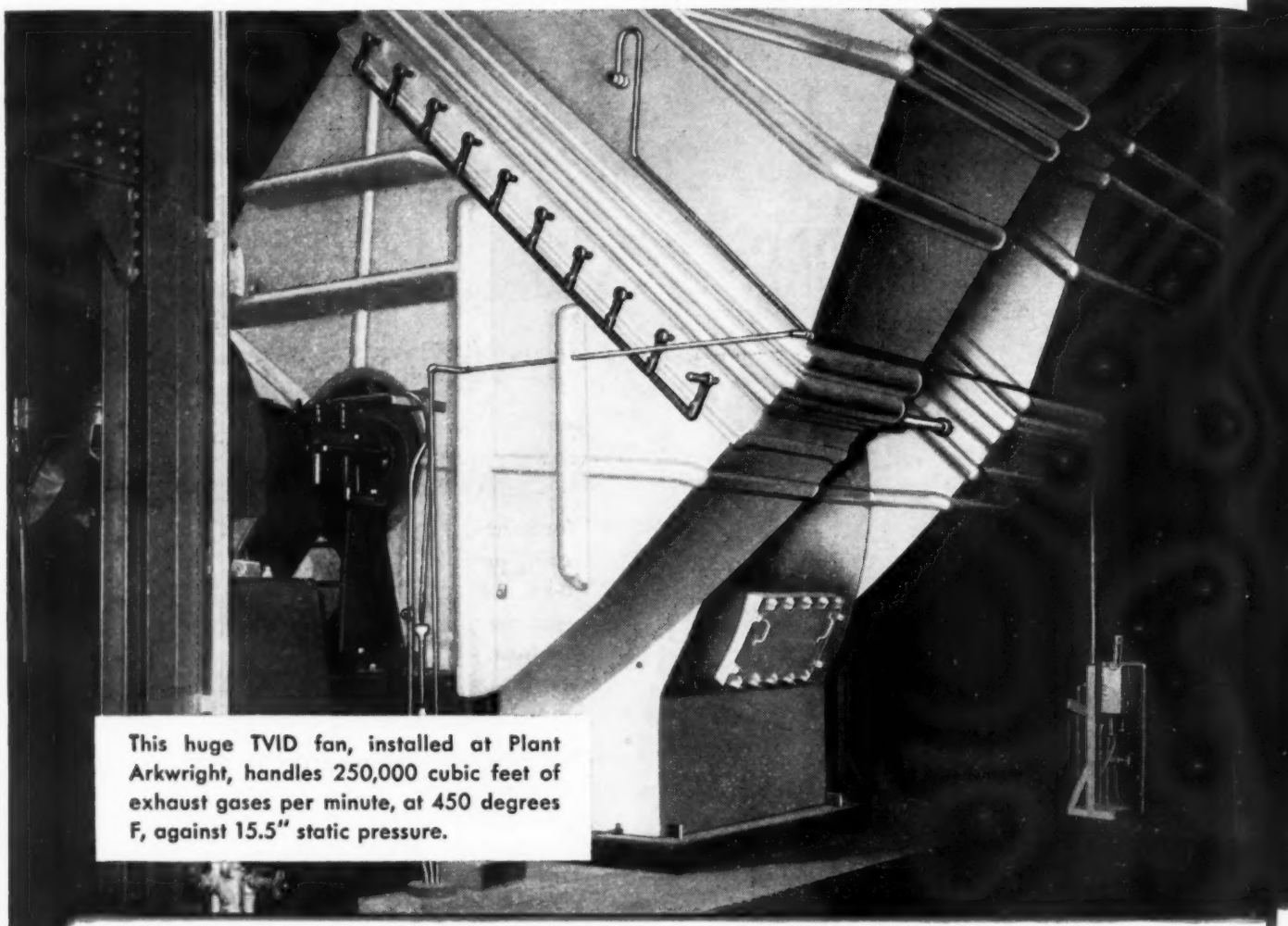


3

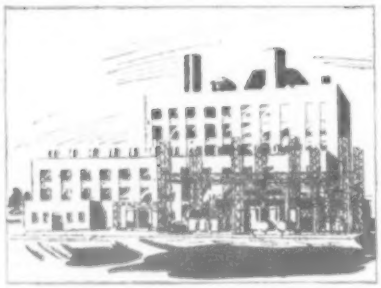
See Yarway Boiler Trim "in action" in the 30-minute color motion picture, "There Is An Engineering Reason." Hear Lowell Thomas describe their principles and operation. Now available without charge for group showings. Write today.

STEAM PLANT EQUIPMENT

STURTEVANT TVID FANS

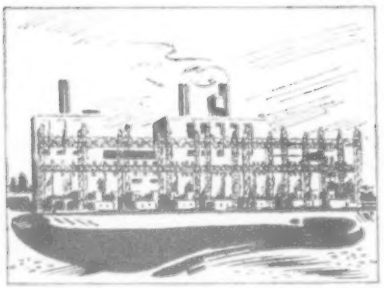


This huge TVID fan, installed at Plant Arkwright, handles 250,000 cubic feet of exhaust gases per minute, at 450 degrees F, against 15.5" static pressure.



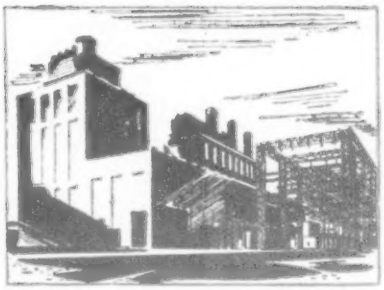
GORGAS STEAM PLANT, ALABAMA POWER CO.

Here, three TVIDs have been on the job for over 10 years—all with an excellent service record. Two are rated 358,000 cfm each, at 560 F, 18" sp; the other, 350,000 cfm, 375 F, 16" sp.



PLANT ARKWRIGHT, GEORGIA POWER CO.

The Design 3 TVID fan shown in the large illustration above was installed here in 1944. Another TVID fan, of the same rating, is now being added for a new 40,000 kw generating unit.



PLANT ATKINSON, GEORGIA POWER CO.

A Design 3 TVID fan rated 350,000 cfm, 375 F, 16" sp, was installed here in 1944—and another, rated 350,000 cfm, 375 F, 13" sp, is now being added for a new 60,000 kw generating unit.

ALL TVID FANS AT THESE PLANTS HAVE LONG-LIFE E-R WHEELS

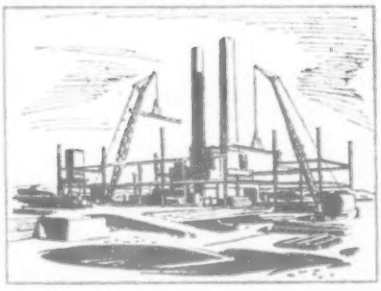
PROVIDE 1,300,000 CFM

FOR NEW GENERATOR UNITS AT GEORGIA POWER and ALABAMA POWER

MORE POWER for Southern industry—more kilowatts for more homes and factories! Keeping pace with this demand, the Georgia Power Co. is adding a 60,000-kw unit at Plant Atkinson and a 40,000-kw unit at Plant Arkwright—and the Alabama Power Co. is adding two 60,000-kw units at the new Gadsden Plant. These new boilers need plenty of induced draft—a total of 1,300,000 cfm! And *all* will be supplied by Design 3 TVID fans with erosion-resisting wheels.

This was no haphazard selection. These power companies *know* what TVID fans can do—from years of experience. Their high efficiency has helped hold down operating costs—and the Sturtevant ER wheel has proved its ability to withstand destructive fly ash *far longer* than any other type of wheel.

It's performance like this—in plants from coast to coast—that's responsible for so many repeat orders for TVID fans. And the same quality and stamina are built into *all* Sturtevant mechanical draft equipment—primary air fans, forced draft fans, induced draft fans, fly ash collectors, steam and electric drives. Whatever your needs, remember that Sturtevant means *satisfaction* in mechanical draft. Write: Westinghouse Electric Corporation, *Sturtevant Division,* Hyde Park, Boston 36, Mass.



GADSDEN STEAM PLANT, ALABAMA POWER CO.

This new 120,000-kw station, now under construction, will have two Design 3 TVID fans, each with a capacity of 350,000 cfm, at 375 F, 13" sp.

Westinghouse

Sturtevant

DIVISION

Lump of coal about to get a move on

This lump of coal has the shakes.

So has all the rest of the coal in any carload that's being emptied by a Robins Car Shakeout.

You see, actual results prove that the cheapest and fastest way to unload a car of stubborn material is to shake it out.

The new Robins Car Shakeout unloads fifty- to seventy-ton cars "broom-clean" in as little as 90 seconds. It unloads them no matter how tightly the load is packed. And it even empties loads that are frozen . . . lets them flow freely and quickly through the hopper doors.

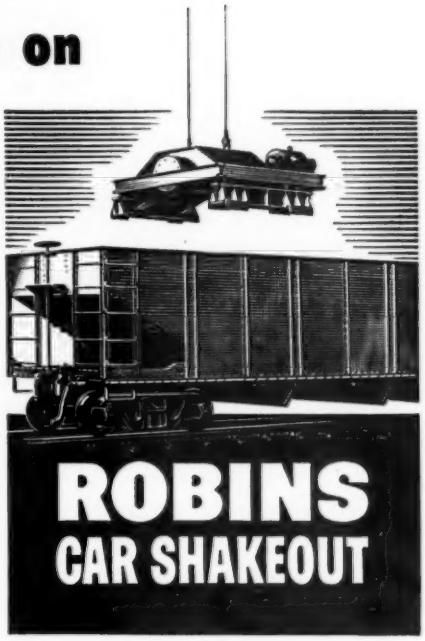
Actual field operations by hundreds of users prove that this new method of unloading hopper cars is as much as twelve times faster than manual unloading methods.

When you can unload hopper cars that fast you practically eliminate demurrage charges!

You save hours of labor, too. All that's required is an operator to lower this portable unit onto the car and press a button. The Shakeout does the rest without damage to the car . . . without danger to the operator.

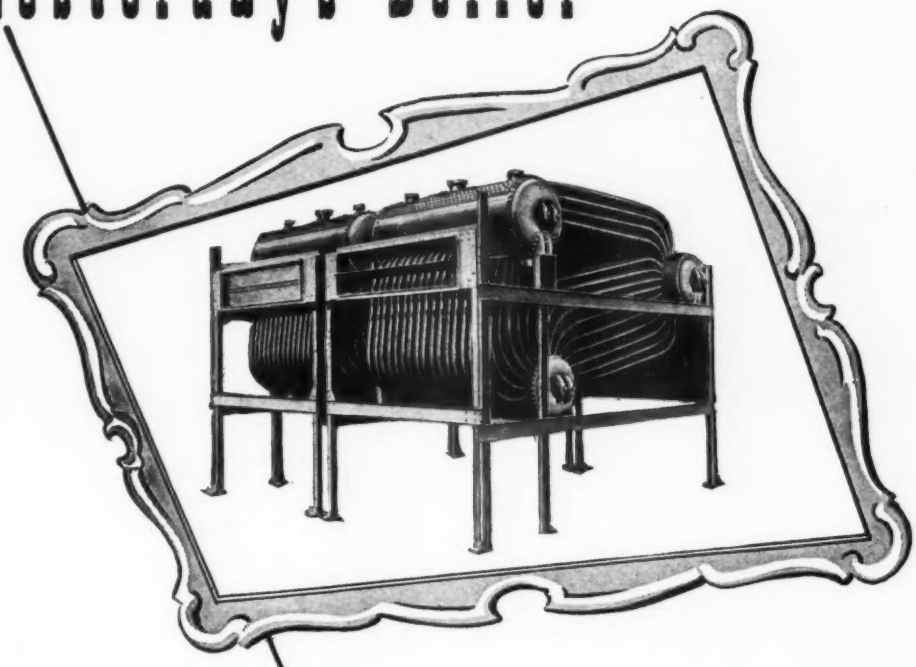
For full details about this revolutionary new way to unload hopper cars in a hurry, write Robins today!

A note on your company letterhead will bring you this new booklet about the Robins Car Shakeout. Tells how this new concept in car unloading saves time, manpower and money. Dept. O-5.



ROBINS CONVEYORS DIVISION, Hewitt-Robins Incorporated, Passaic, N. J.

Yesterday's Boiler



still generates STEAM

BUT . . . your profits are determined by today's cost of fuels and cost of operation.

Consider what you pay for fuel today—two times what you paid before the war. Remember that operating labor rates have doubled since 1939.

However, technological advances during the last two decades have offset these increases to the extent that the average price of electricity today is lowest in the history of the industry.

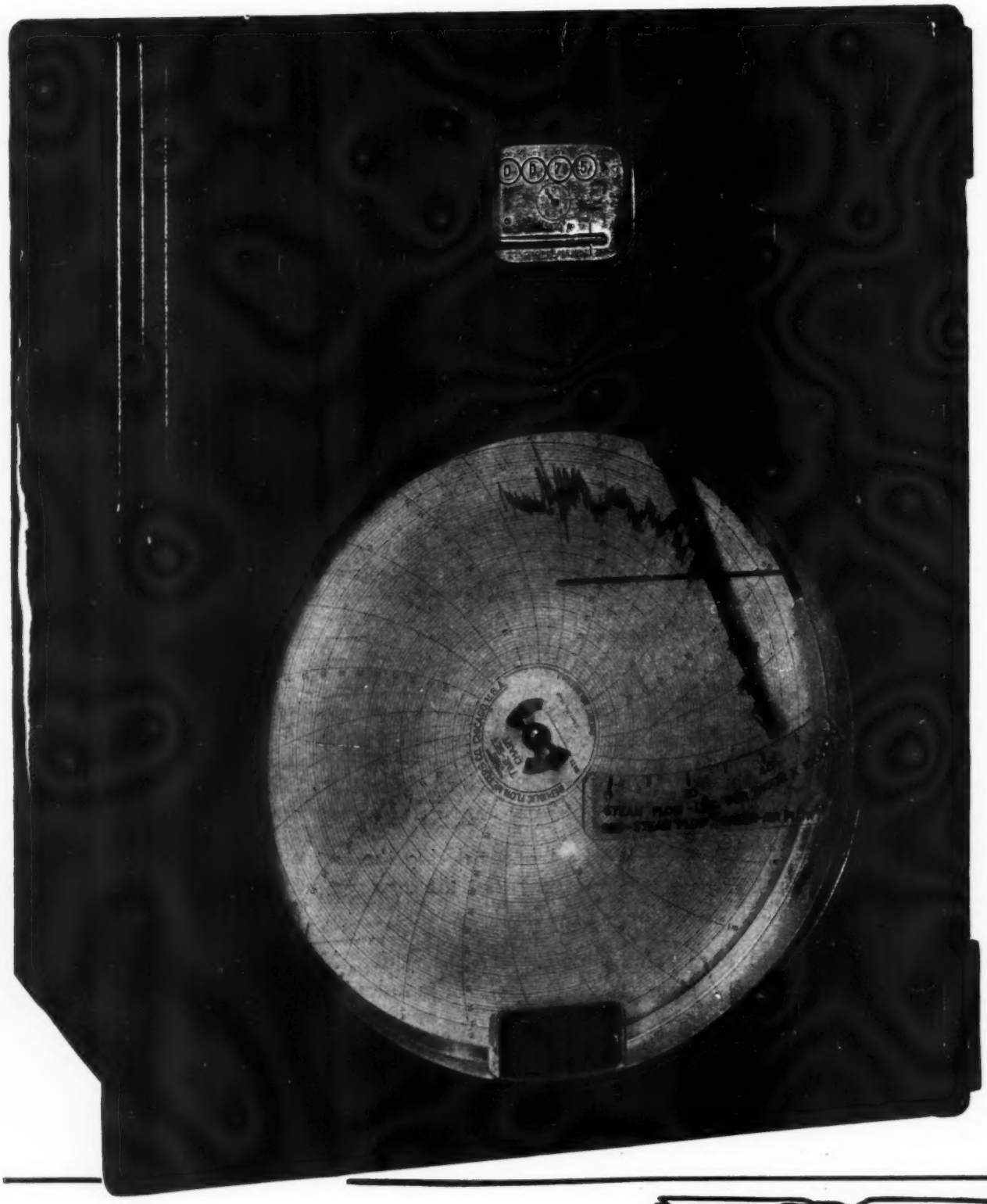
It stands to reason that you must have modern high efficiency steam generating equipment to be competitive in today's market.

Foster Wheeler's engineering "know how" is the answer to the pertinent question of how to reduce your operating costs.

FOSTER WHEELER CORPORATION

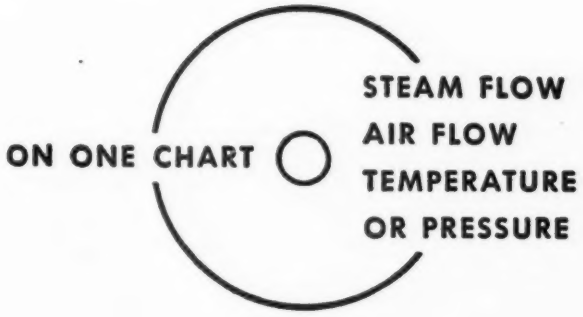
165 BROADWAY, NEW YORK 6, NEW YORK

Write for Data on the



REPUBLIC
INSTRUMENTS
AND CONTROLS

Republic Boiler Meter



● The new Republic Boiler Meter provides, in one instrument and on one chart, all the essential information concerning boiler performance regardless of the size or type of boiler, kind of fuel or method of firing.

The meter indicates, records, and integrates steam flow from the boiler and records rate of air flow for combustion. When the correct amount of air for maximum combustion efficiency is being supplied the air flow pen will record coincident with the steam flow pen, regardless of the load being carried by the boiler.

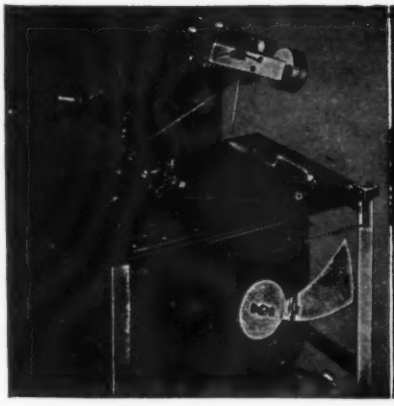
A third pen recording flue gas temperature (or steam pressure) can be added thereby providing the operator with complete information, on one 12-inch chart, relative to the performance of the boiler at any given time.

The Republic Boiler Meter is primarily a boiler operating guide. The two records, steam flow in red and relative air flow in blue, tell the operator instantly whether correct combustion and furnace conditions exist, thereby enabling him to correct faulty conditions when they occur.

The Republic Boiler Meter consists of a standard Republic electric steam flow recorder and integrator and an oil sealed, bell type air flow element.

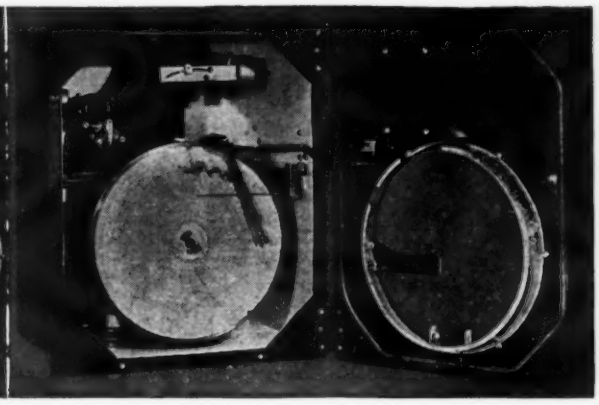
The air flow element consists of an oil sealed bell in a sealed chamber. The motion of the bell is transmitted through a diaphragm seal. This arrangement permits the use of a single bell—the high pressure being applied to the top of the bell and the low pressure under the bell. This arrangement also excludes air and dirt from the oil. The motion of the bell is transmitted to a cam system which extracts the square root, or when adjusted for a particular installation, compensates for chimney action and variable excess air requirements. The air flow pen is attached to the cam system with an adjustable linkage which permits changing the steam flow air flow ratio as conditions may require.

The entire operating mechanism is housed in a rugged steel case and can be easily removed as a single unit by merely loosening two anchor bolts and disconnecting the two air connections. The meter may be either wall mounted or flush mounted on a steel panel. *Write for Bulletin No. 420.*



Meter assembled as one unit on rack ready for calibration.

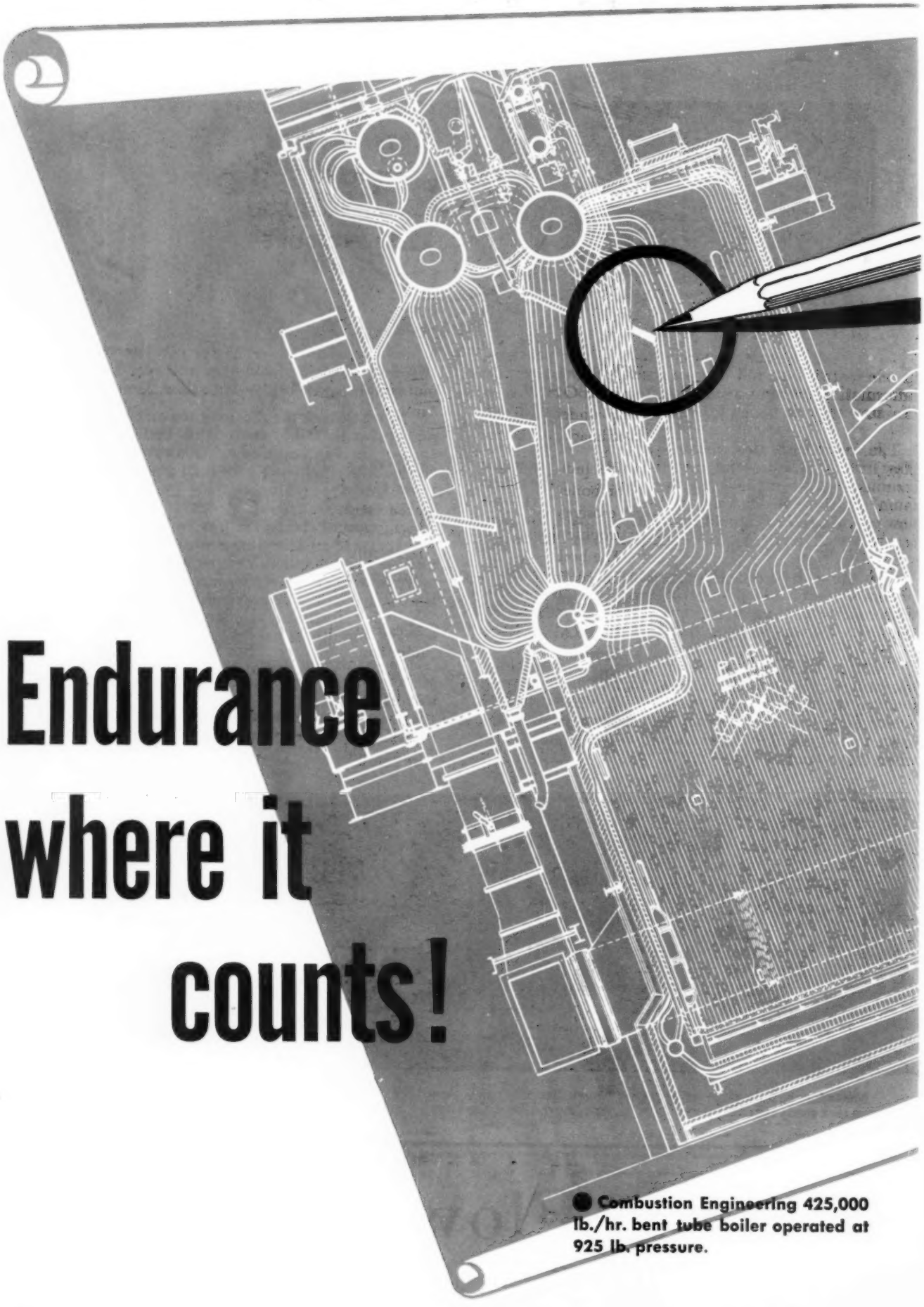
Meter assembly can be easily removed from the case.



Meter with door open showing accessibility of all adjustments and working parts.

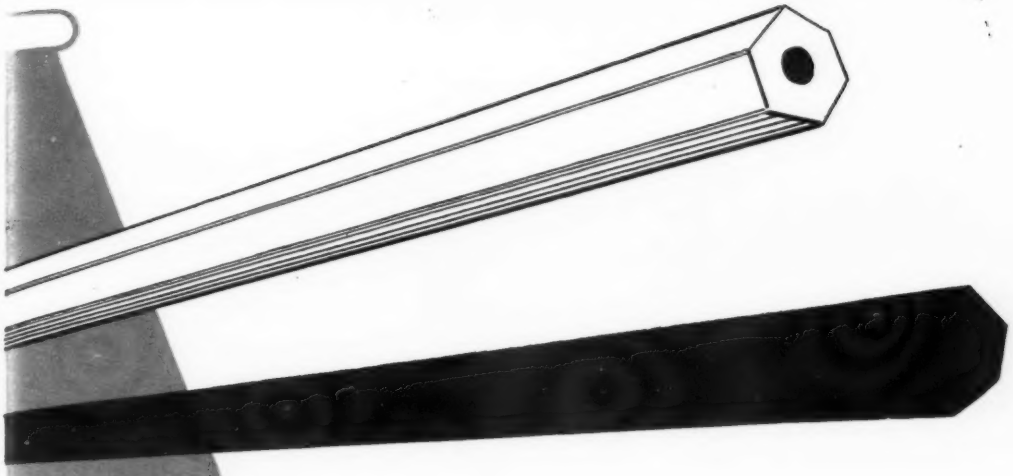
Republic Flow Meters Co.

2222 Diversey Parkway · Chicago 47, Illinois



Endurance where it counts!

● Combustion Engineering 425,000 lb./hr. bent tube boiler operated at 925 lb. pressure.



HERE is case history evidence that CARBOFRAX silicon carbide tile can stand up under punishment that quickly causes ordinary refractories to fail.

The baffle indicated in this drawing of a bent tube boiler is subject to rigorous spalling and erosive conditions. Fireclay tile used in this trouble spot lasted only four to six weeks. The boiler was shut down repeatedly for baffle replacement. Output dropped. Maintenance costs jumped.

A CARBOFRAX baffle 18″x12″x2″ extending the entire 29′ width of the tube bank was installed. It has been in use more than 3 years . . . and is still going strong. During the last two years, severe conditions have been even tougher due to the sand blast action of a soot blower operating at 200 lb. pressure installed directly above the baffle. Destructive scurfing is counteracted by the high abrasion resistance of CARBOFRAX tile at elevated temperatures. Flame erosion and thermal changes are resisted. Continuity of operation, increased steam production, freedom from baffle maintenance, and lower costs are provided.

This example of their ability to lick trouble spots is another reason for checking the possibilities of CARBOFRAX brick and tile for your boiler furnaces. Used in large or limited areas, they help eliminate expensive and frequent downtimes for refractory repairs. Engineering assistance is at your service through Dept. G-107. The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.

SUPER REFRACTORIES

BY CARBORUNDUM

TRADE MARK

"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company

IT'S RAINING-
IT'S POURING
--SO WHAT!

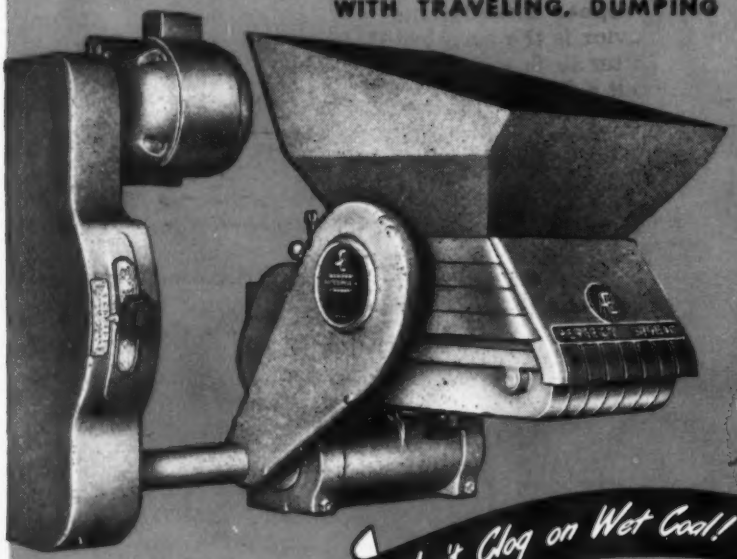
A coal supply that is wet, dry, or partially frozen will no longer be a problem with an Æ Perfect Spread Stoker in your boiler room. You will be able to feed it a wide variety of fuels and watch it operate quietly and efficiently—without clogging. Whether you're now hand-firing your boilers or want to replace inefficient boilers, you'll appreciate the exclusive Æ features that assure you automatic steam generation with consistently thorough combustion at low operating cost.

Its efficient performance has saved thousands of dollars for scores of owners in many types of businesses. Reduce *your* boiler room costs with the Æ Perfect Spread Stoker. Investigate now. Write for descriptive booklet today!

PERFECT SPREAD STOKER

Æ

WITH TRAVELING, DUMPING OR STATIONARY GRATES



Won't Clog on Wet Coal!

ALWAYS PLENTY OF STEAM —AUTOMATICALLY

The Æ Perfect Spread Stoker responds immediately through automatic controls to sudden and extreme changes in the steam load. It can run from a banked fire to more than twice the normal rating in a few minutes. Gets steam up fast and keeps it there!

FREE—Get this valuable descriptive booklet on the Æ Perfect Spread Stoker today!

Address inquiries to 2400 Aramingo Ave., Philadelphia 25, Pa.

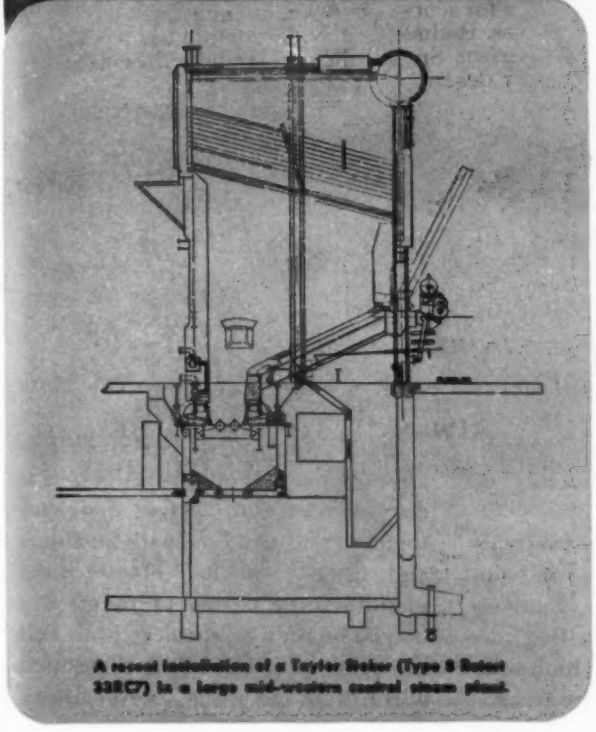
Other Æ Products: Æ-TAYLOR STOKERS, LO-HED HOISTS, MARINE DECK AUXILIARIES, HELE-SHAW FLUID POWER

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVENUE • PHILADELPHIA 25, PA.

NOT FINICKY ABOUT ITS FUEL!

The Æ Taylor Stoker, like this soaring scavenger, is not "fussy" about what it consumes. Its fuel-versatility enables you to feed it a wide variety of types and sizes of coal which often means more efficient, thorough combustion with a lower grade of fuel than you are now using. This obviously results in important savings to you—a significant feature you should not overlook when selecting fuel-firing equipment for your power plant operations.



A recent installation of a Taylor Stoker (Type S Rotoist 338C7) in a large mid-western central steam plant.

WATCH THE TREND!

THE TREND IS TOWARD TAYLOR

It is quite probable that you are already acquainted with the exclusive Taylor features that make this fuel - flexible stoker first choice with buyers wherever underfeed stokers are used. Throughout industry, the trend is toward Taylor for both original and repeat installations —Taylor is the time-tested, proven, economy stoker.

Better air flow and precision control feed mechanism are but a few of the advantages that aid in giving you efficient low-cost steam generation. With simplified construction throughout, there are fewer moving, longer wearing parts. These outstanding improvements are backed up with over 40 years of engineering "know how" with emphasis placed on features that mean efficient, automatic, low-cost steam production.

Join the hundreds of engineers, plant superintendents and purchasing agents who specify Taylor for *their* power plant equipment. They know—*it's the leader.*

UP-TO-DATE FACTS ON THIS IMPROVED TAYLOR STOKER

If you aren't up to the minute on Stokers, get your copy of this booklet. Write to Department 24 today!

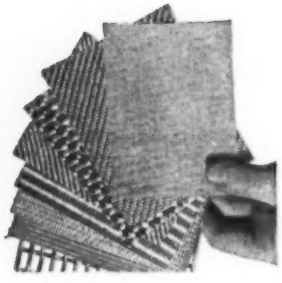
TAYLOR STOKER

Æ

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVENUE, PHILADELPHIA 25, PA.

Look at this answer to Screen and Filter Cloth problems



ALL WEAVES AND MESHES! Longer-lasting wire cloth of Monel, Nickel or Inconel is available in all weaves and meshes. Many weaves actually cost less than cloth of less durable metal.

Filter or screen elements stay on the job longer when made of Monel*, Nickel or Inconel*.

For these are the "task metals" of industry.

Compare them with any fabric or metal cloth that is causing you trouble. Wire cloth of these metals is rustless . . . corrosion-resisting . . . strong...tough. It endures high temperatures. It stands abrasive wear.

Its longer service life means fewer replacements . . . fewer operating hours lost.

Many equipment manufacturers already have standardized on this durable wire cloth to free their customers from troubles with strainers and filter elements! Maybe your manufacturer is one of them. But maybe he isn't. So speak to him. Tell him you want the extra protection of the "task metals" wherever filters, strainers or screens are used.

Send for our booklet: "Established Weavers of Monel, Nickel and Inconel Wire and Filter Cloth."

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
INCO
TRADE MARK

Monel* Nickel Inconel*

*Reg. U. S. Pat. Off.

"Task Metals" for Industry

ARMSTRONG UNIT TRAPPING* *cuts fuel costs*

PACIFIC NUT OIL COMPANY
Producers of Vegetable and Nut Oils and Meals
4615 BANDINI BOULEVARD
LOS ANGELES, CALIFORNIA

April 25, 1946

Guy L. Warden,
209 West 12th St.,
Los Angeles (15), Calif.

Attention: Mr. John Ward

Gentlemen:

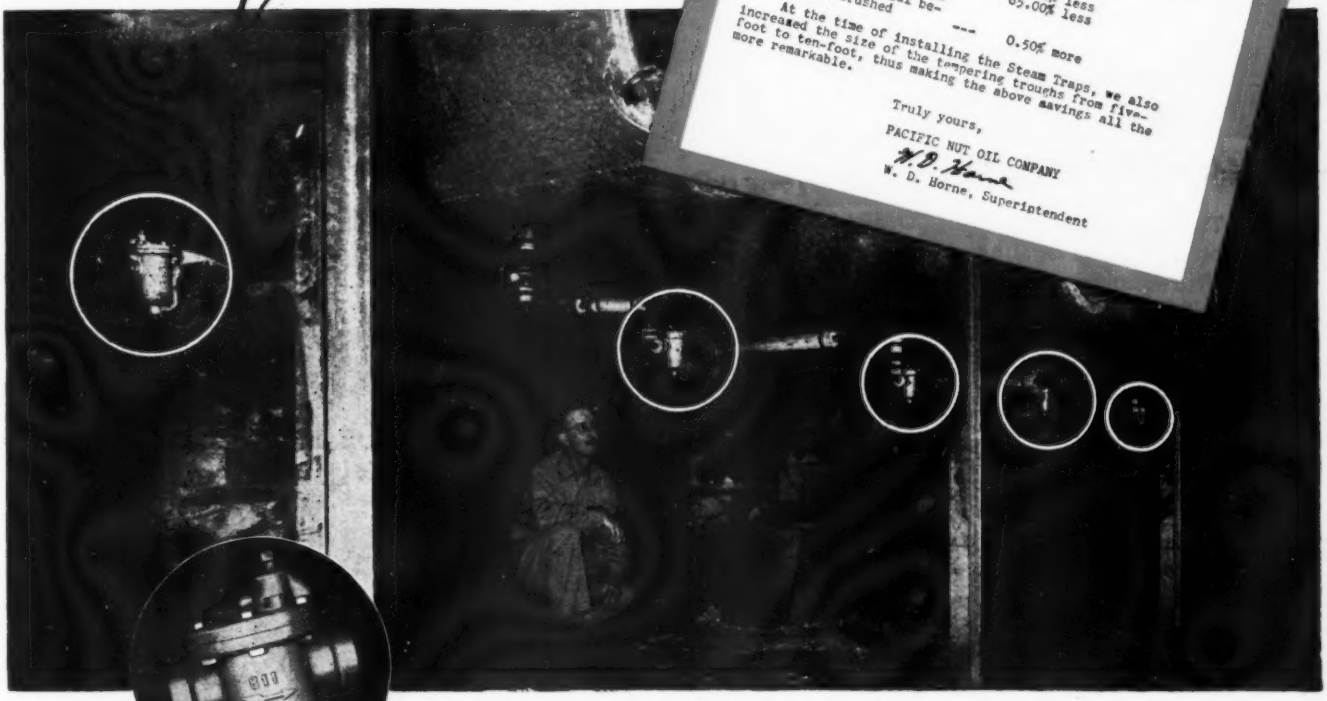
We have just completed making an analysis of the savings realized by the installation of Armstrong Steam Traps on fifteen Anderson Expeller Tempering Troughs, and thought you would be interested in the results of same.

The Steam Traps were installed during the last week in February; we therefore made a comparison of the month of February with the first 28 days of the month of March, with the following results:

Fuel Consumption	---	30.00% less
Water Consumption	---	65.00% less
Extraction of Oil from material being crushed	---	0.50% more

At the time of installing the Steam Traps, we also increased the size of the tempering troughs from five-foot to ten-foot, thus making the above savings all the more remarkable.

Truly yours,
PACIFIC NUT OIL COMPANY
W. D. Horne
W. D. Horne, Superintendent



***ARMSTRONG UNIT TRAPPING**

WHAT? It is providing an individual trap of correct size and type for each separate steam condensing space.

WHY? Prevents short-circuiting, air locking, water pockets, sluggish drainage. Removes both air and condensate.

WHERE? Every place where steam is used.

WHEN? The sooner the better.

HOW? See your local Armstrong representative, or write.

ARMSTRONG STEAM TRAPS

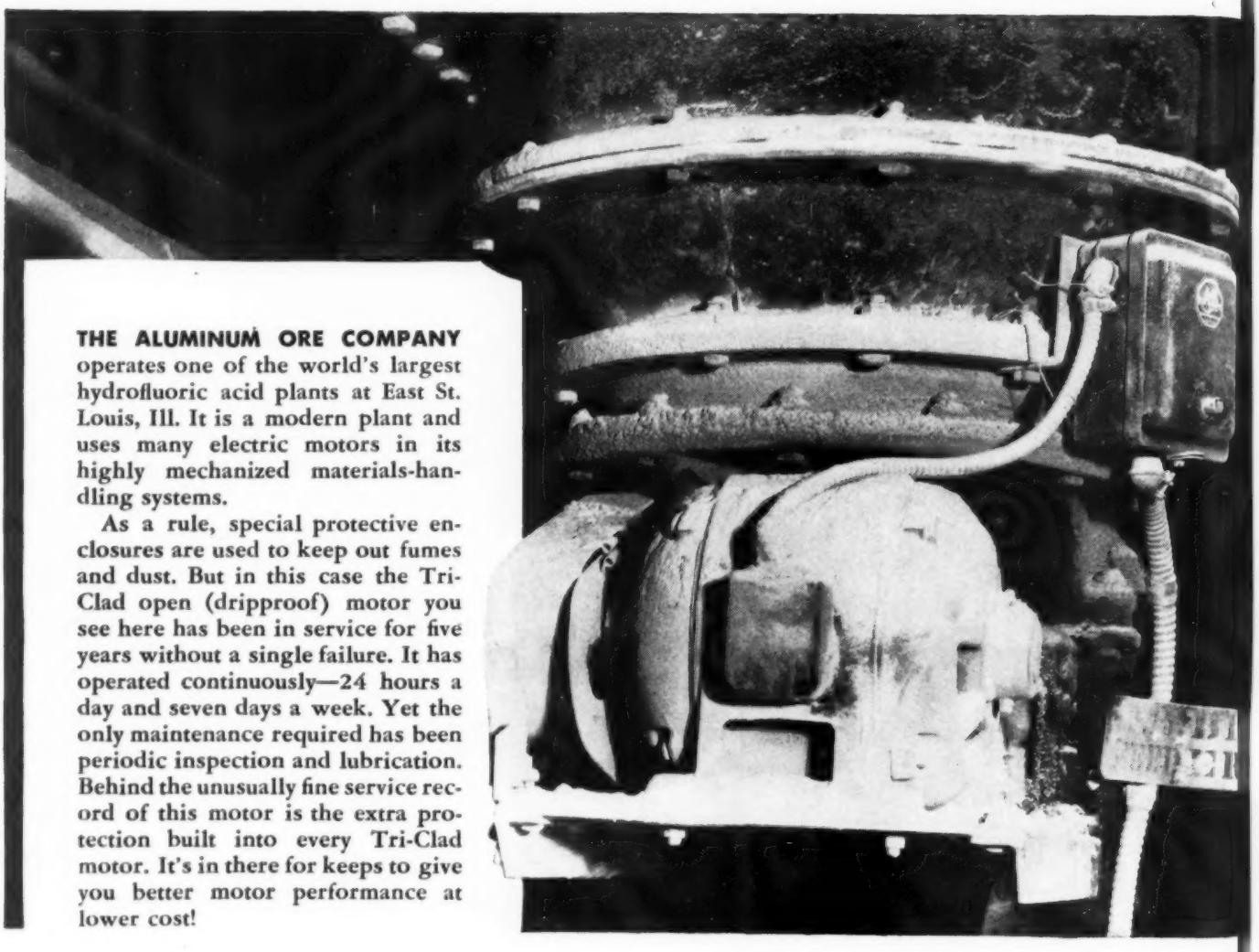
boosts output...

The experience of the Pacific Nut Oil Company in cutting costs and boosting output through the use of Armstrong Traps is not unusual. Eastern Box Co., Baltimore, Md., estimates fuel savings of 20% . . . Ralph L. Smith Lumber Co., North Kansas City, Missouri, cut more than six hours off time required to treat battery separator plates . . . Kerber Packing Co., Elgin, Ill., reduced rendering time in jacketed kettles 25%.

If you are interested in getting the benefits of Armstrong Traps and the Armstrong Unit Trapping, see our local representative at once. Complete information on request.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.

4 MILLION HP



THE ALUMINUM ORE COMPANY operates one of the world's largest hydrofluoric acid plants at East St. Louis, Ill. It is a modern plant and uses many electric motors in its highly mechanized materials-handling systems.

As a rule, special protective enclosures are used to keep out fumes and dust. But in this case the Tri-Clad open (dripproof) motor you see here has been in service for five years without a single failure. It has operated continuously—24 hours a day and seven days a week. Yet the only maintenance required has been periodic inspection and lubrication. Behind the unusually fine service record of this motor is the extra protection built into every Tri-Clad motor. It's in there for keeps to give you better motor performance at lower cost!

The toughest TRI-CLAD ever built!

Newest addition to the Tri-Clad motor family is the Tri-Clad totally enclosed, fan-cooled motor. It is designed for use in adverse atmospheres—in iron dust, out-of-doors, in hazardous areas, and chemical atmospheres. Available in both standard and explosion-proof types, this motor gives you these important construction features:

- A cast-iron, double-wall frame which completely encloses and protects the windings and punchings.
- A non-shrinking compound around motor leads which protects motor interior from dust and moisture.
- A rotating labyrinth seal which further protects the motor interior from damage by foreign matter.

CONFIRMS IT!

FOR TOUGH MOTOR JOBS, YOU CAN'T BEAT

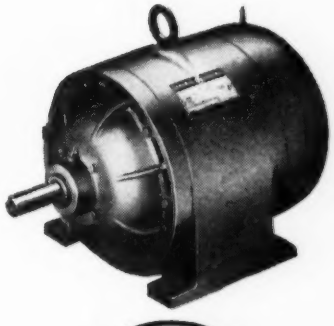
TRI CLAD

EXTRA PROTECTION

To date, a million and a half Tri-Clad motors, with a total output of over 4-million horsepower, have been purchased by American industry!

In every kind of plant from steel mill to dairy, these motors are proof beyond doubt that you can't beat Tri-Clad extra protection for tough motor applications. Even on jobs where special protective enclosures would ordinarily have been specified, Tri-Clad open motors, applied during the war years, have stood up to heat, dust, and dampness, operating smoothly and efficiently for years with only minimum maintenance.

Today, the Tri-Clad family includes many different types and sizes. But whatever your selection, the Tri-Clad motor nameplate is still your best assurance of a high return on your motor dollar. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*



EXTRA PROTECTION . . . *AGAINST PHYSICAL DAMAGE!*

Rigid cast-iron frame and end shields protect vital motor parts from external abuse. Because they're not at the mercy of a coat of paint, they strongly resist chemical attack and dampness. Cast iron also gives you wide nonyielding metal fits between end shields and frame for ease of assembly.

EXTRA PROTECTION . . . *AGAINST ELECTRICAL BREAKDOWN!*

Motor windings of Formex* wire, together with improved insulating materials, reduce the chances of electrical failure. Heat is dissipated quickly—motor stays young for years and years!

EXTRA PROTECTION.. *AGAINST OPERATING WEAR AND TEAR!*

Bearing design affords longer life, greater capacity, improved lubrication features. Bearing seals retain lubricant, keep out dirt. One-piece, cast-aluminum rotor is practically indestructible.

**Trade-mark reg. U.S. Pat. Off.*

GENERAL ELECTRIC

750-287

TRI CLAD

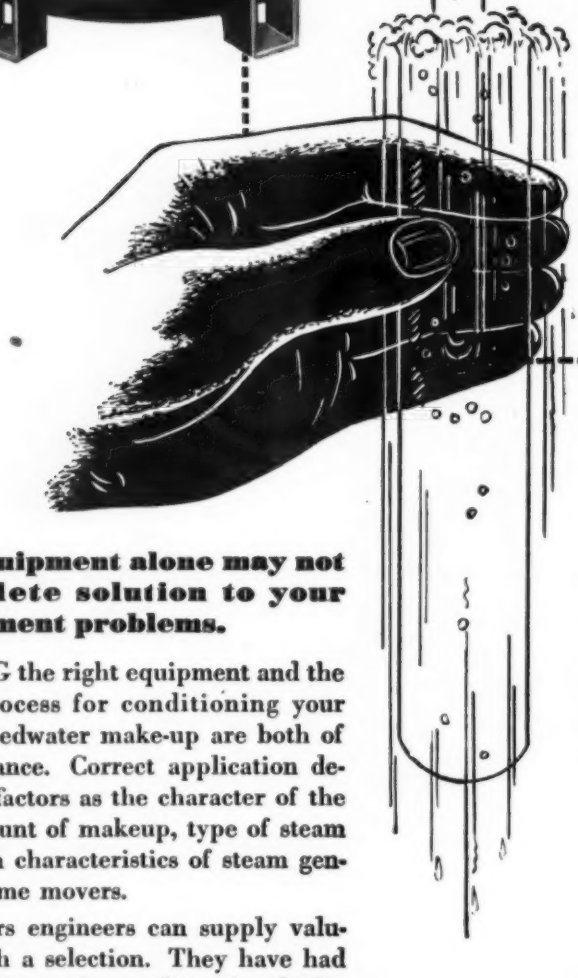
REG. U.S. PAT. OFF.

MOTORS

- OPEN (DRIPPROOF)
- TOTALLY ENCLOSED
- EXPLOSION-PROOF

Good Water

COMES FROM GOOD EQUIPMENT!



But good equipment alone may not be a complete solution to your water treatment problems.

CHOOSING the right equipment and the right process for conditioning your boiler feedwater make-up are both of highest importance. Correct application depends on such factors as the character of the raw water, amount of makeup, type of steam load and design characteristics of steam generators and prime movers.

Allis-Chalmers engineers can supply valuable aid in such a selection. They have had extensive experience in conditioning boiler water for both high and low pressure power plants. In addition, their recommendations will be unbiased, because Allis-Chalmers offers a complete line of equipment that includes Hot and Cold Process Softeners, Sodium and Hydrogen Zeolite Softeners, Degasifiers, Deionizers, Chemical Proportioners, Filter Backwash Pumps, and Oil and Water Filters.

For prompt assistance with any water conditioning problem, call your nearest A-C office or write ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 2316

Shown above is sectionalized view of filter tank. Send today for complete details of Hot Process Softeners in Bulletin 28B6611.

ALLIS-CHALMERS

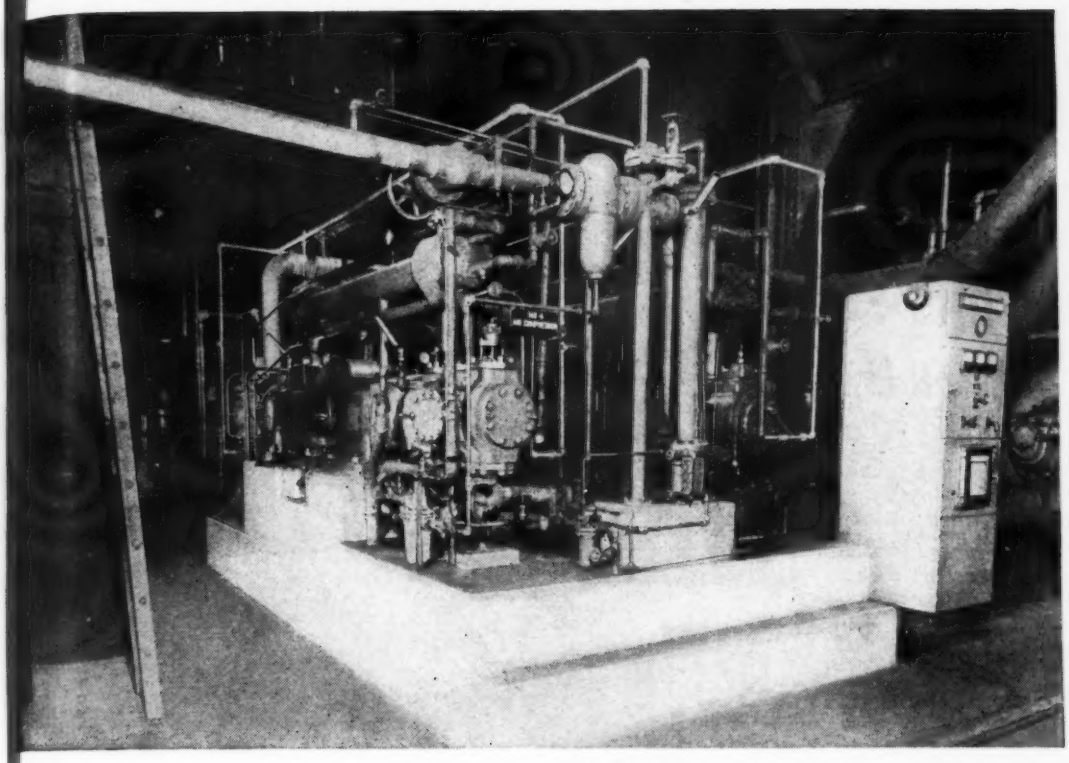
One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

1847 1947 A CENTURY OF SERVICE to Industry THAT MADE America Great

NEWS

FROM THE POWER FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS, FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON



Worthington Compressor at Kearny Generating Station.

Air Cleans Boilers Better Than Steam

General practice in cleaning boiler walls and tubes is to blow saturated steam into the boiler under high pressure. This method is preferred in many plants despite the fact that modern steam boilers are delicately balanced and any considerable use of steam for this purpose necessitates bringing in new water that has to be treated, heated, etc.

At the Kearny Generating Station of Public Service of New Jersey, a further objection was a tendency for "quench cracks" to form in the high-temperature-resistant alloy tubes, particularly around the cleaner port.

Soot cleaning at Kearny (as elsewhere) became more of a problem during the war, when the ash content of the soft coal burned in the boilers increased substantially. Even now, ash runs about 10 to 12%.

To simplify cleaning, Public Service decided to abandon steam in favor of compressed air, and the Mercury boiler at the Kearny Station was equipped with a compressed air system installed by Worthington.

Air at Two Pressures

The 1000 cfm compressor delivers air at 500 lb pressure. The air passes through oil removers, then goes to a 1000 cu-ft storage receiver located on the outside of the building. From this large receiver air passes through a reducing valve and enters the 100 cu-ft tank where 250 lb pressure is maintained. Operating with air at two different pressures permits the use of a smaller compressor, since the air may be stored at the higher pressure between blowing operations and expanded to the lower working pressure as needed.

Because of the size of the boiler and the fact that a considerable number of soot blowers are needed to keep the surface clean and provide for good heat transfer, provisions have been made to do the cleaning automatically, and a regular cycle has been developed. The cleaning goes on continuously while the boiler is in operation.

It is intended to have all new boilers now under construction at the Essex and Sewaren Stations blown by air. Performance of the Worthington compressor has been completely satisfactory, particularly in respect to the small amount of maintenance.

Year 'Round Air Conditioning at WSPA Radio Station

A 24-ton year-'round air conditioning unit which cools and dehumidifies in the summer, heats and humidifies in the winter, has been installed in radio station WSPA, Spartansburg, S. C., by Montgomery & Crawford, Inc., Worthington distributor.

The air unit is a Worthington DH-440 with cooling and heating coils. Two Worthington 3HF4-10S condensing units (10 hp.) are connected in parallel with oil and gas equalizer lines. Both of these machines are mounted on a concrete base. The installation uses a 28C4 evaporative condenser mounted on the outside rear of the studio building.

NEWS from the power front

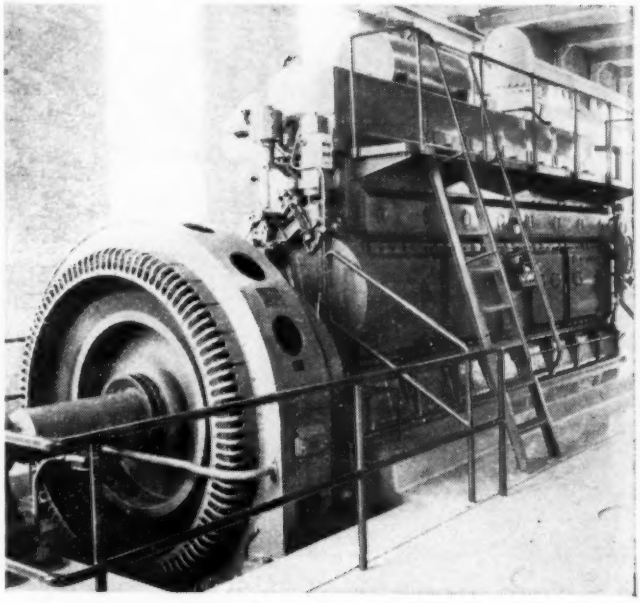
Supercharged Dual-Fuel Diesel Goes Into Service

. . . Over 36% Thermal Efficiency

What can be accomplished by supercharging a dual-fuel Diesel engine has been demonstrated by the performance of the new Worthington engine in the municipal power plant at Lamar, Colorado.

This 1530 hp engine, recently installed to drive a 1080 kw generator, has turned in a record of over 36% thermal efficiency—7050 net btu per brake horsepower hour (total of gas and pilot oil fuels) at full load. Elevation is 3600 ft.

The Worthington engine at Lamar uses natural gas on the Diesel cycle, but in case of gas line failure, it is quickly convertible(by a turn of a wheel) to Diesel oil or any mixture of gas and oil. With gas, the fuel cost is slightly more than one mill per kw.

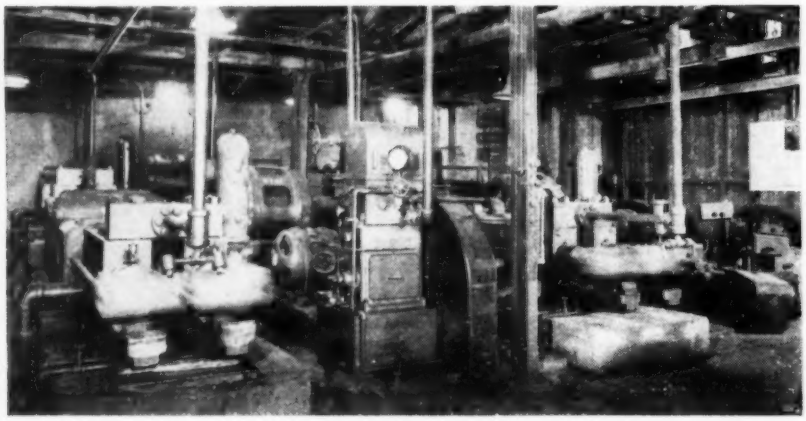


SEHGO-8 supercharged Worthington Dual-Fuel Diesel engine.

Horsepower Increased 50%

The supercharger utilizes the energy of the engine exhaust to drive a blower which supercharges the engine. In addition to increasing horsepower about 50%, this improves mechanical efficiency and scavenging, resulting in lower fuel consumption. Lubricating oil requirements are also reduced. Further economies result from the lower installation cost: less building space, smaller foundations, etc.

The new generating unit is being used for peak loads and standby services.



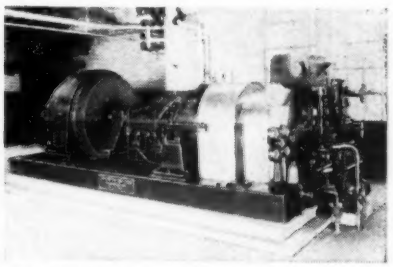
Pump room at The Electric Hose & Rubber Co.

Pumping Lower Costs Into Electric Hose

Installation of new pumping, as part of a one million dollar program of modernization, is credited with helping The Electric Hose & Rubber Co. of Wilmington, Delaware, to increase output to 140 million feet a year (nearly 50% above the wartime level) and to reduce prices 18-30%.

The pumping equipment consists of four Worthington horizontal duplex Type KUF power pumps with 1¾ in. bore x 12 in. stroke. Each is direct-driven by a 200 hp 3-phase, 60-cycle, 2300 volt, 600 rpm motor. Each pump furnishes liquid under 5000 psi to individual 2100 ton 33"/11½" Watson Stillman lead extrusion presses. An independent piping layout for each pump and press constitutes the pumping system. About 10 ft suction head is maintained. Each pump is rated at 40 gpm, 6000 psi, at 84 rpm.

Supplementing the hydraulic power for the major extrusion process is a Worthington vertical triplex size 2 x 4 VTE power pump rated at 50 gpm, 950 psi at 350 rpm, driven through Worthington Multi-V-Drive by a 30 hp, 1160 rpm motor. This pump is tied into a weighted type accumulator which furnishes liquid under pressure to the lead billet hydraulic lift on each 2100 ton press.



Worthington 500 KW turbine at New York's Incinerator Plant on 56th St.

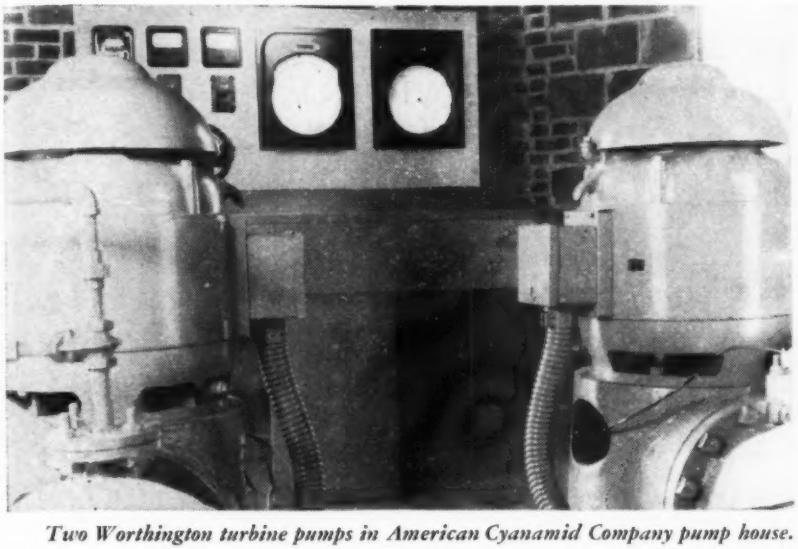
The Incinerator on 56th Street

New York City maintains an incinerator plant on 56th Street. This plant uses the heat generated in burning refuse to make power for operating the cranes, lights and plant auxiliaries.

Two Worthington 500 KW alternating current geared turbine-generator units supply the power. Installed in 1936, they operate on steam at 200 lbs pressure supplied from the waste heat boiler and exhaust at 5 lb back pressure.

Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS



Two Worthington turbine pumps in American Cyanamid Company pump house.

Worthington Helps Ranney System at American Cyanamid Company

American Cyanamid Company's new plant in Wallingford, Conn., is located on sandy flats adjacent to the new (as yet unfinished) Merritt Parkway out of New York City.

One of the principal problems was to find a suitable source of process water. The plant being located in a valley, it was presumed that enough ground water would be available. But after six wells had been placed in operation, it was found that the geological formation was such that the water supply dwindled, leaving no reserve for plant expansion.

A survey of subterranean water sources was made by an experienced geologist who disclosed that a valuable aquifer existed on the property. One of the latest types of water collecting system, designed by the Ranney Water Collector Corporation of New York, was installed.

The system works this way. 1, A large area of water-bearing formation is exposed to horizontal screen pipes located below the ground water table. 2, Selective removal of the fine material from the aquifer in the vicinity of the screens and the formation of more permeable ground or a gravel pack adjacent to the screens produce a series of radiating drainage canals emptying into a central shaft. 3, The lines lead to portholes in the lower section of a concrete cylinder, sealed at the bottom. (In this case, the caisson is about 90 feet deep.)

This compact unit is capable of producing, for American Cyanamid Company, 5 million gallons per day. The water is colorless, odorless, tasteless and bacteria-free due to the large infiltration area and the 80-ft depth of sand and gravel through which it travels to reach the collector pipes.

Worthington In the Pumping Station

This system is capable of producing 5 million gallons per day—far more than needed at present.

Two Worthington turbine pumps were selected for the pumping station. Each has a capacity of 1000 gpm. The flexibility provided by the Worthington design is ideal because added capacity can be obtained from each pump at moderate additional cost.

Water from bottom of caisson is pumped to a supply tank located above ground, from which it feeds two Worthington centrifugal Monobloc pressure pumps supplying the plant pressure system.

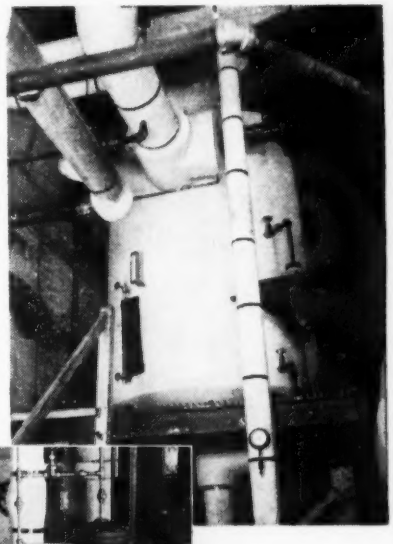
Deaerating Feedwater Heater Earns $60.00 Per Day

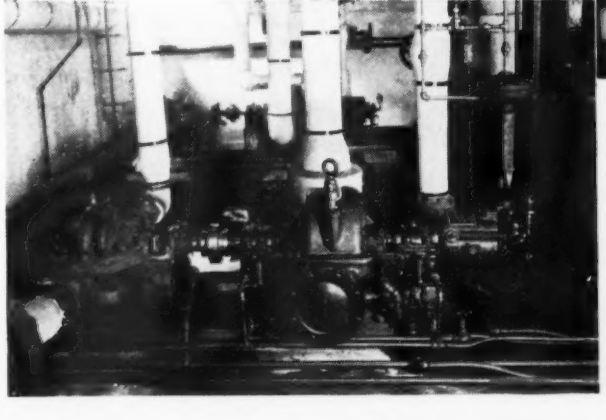
Using undeaerated feedwater at 140 degrees gave Providence Dyeing Bleaching and Calendering Company a lot of trouble with leaking boiler tubes. Then a new Worthington 80,000 lb per hr Deaerating Feedwater Heater was installed; delivering deaerated water at 240 degrees, it stopped the trouble and provided a bonus of $60.00 a day in the form of reduced fuel cost.

Operating figures for the job are: 100,000 lb per hr maximum, 15 ft NPSH, 3550 rpm, 160 lb pump discharge, 150 lb steam at turbine throttle, 10 lb steam turbine back pressure.

The hot water returns are pumped from a surge tank to the heater by means of a Worthington turbine driven Monobloc pump with a motor driven Monobloc pump as standby.

The flow of returns to the heater is controlled by a float-operated regulating valve on the heater. There is also a regulating valve on the heater for controlling flow of emergency cold water make-up when and if needed by the heater.





(Photo above)—Worthington Deaerating Heater at Providence Dyeing Bleaching and Calendering Co. 0.03 cc. oxygen per litre deaeration, 2 minutes water storage.

(Photo at left)—Worthington 2-UB-2 Centrifugal Boiler Feed Pump driven by Worthington-Moore R2R Steam Turbine (Stand-by in background).

7-7

FIGURE 2228
LUNKENHEIMER
NEW 200 LB.
BRONZE UNION BONNET GATE VALVE

BUILT TO LUNKENHEIMER STANDARDS

Fig. 2228

DESIGNED WITH FULL CYLINDRICAL BODY SECTIONS to provide maximum resistance against distortion of the valve body and seats due to pipe line stresses and internal pressure strains. Exhaustive tests made under conditions far more severe than those encountered in actual service clearly demonstrate that this design will not distort and will maintain initial proportions and seat tightness.

All parts are heavy and rugged and of the finest materials to insure ample factors of safety against pressure, temperature and operating strains.

Send for descriptive circular No. 534.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI 14, OHIO, U. S. A.
NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 34
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

PHONE YOUR LUNKENHEIMER DISTRIBUTOR

Fig. 2228 valves and companion valves are available through your Lunkenheimer Distributor. Call on him for prompt service and the best in valves . . . Lunkenheimer.

BRONZE, IRON, STEEL, AND CORROSION RESISTANT ALLOY VALVES
AIR DEVICES, LUBRICATORS, AIRCRAFT FITTINGS

for better service....

NOTE THESE FEATURES

Malleable Iron Handwheel—Non-heat, easy, comfortable grip.

Rising Stem—Made of a distinctive silicon bronze alloy, developed and patented by Lunkenheimer. Remarkably wear-resistant, eliminates stem-thread failures. Exceptionally heavy stem head.

Hexagon Head Gland—Permits use of a wrench to loosen gland. Facilitates repacking.

Stuffing Box—Large and deep. Long thread provides solid engagement with packing nut to form a tight joint when fully packed.

Repacking Seats—Repackable under pressure when wide open. Repacking seats above stem thread, perfectly machined.

Bonnet—Union bonnet 2 in. and smaller; bolted bonnet 2½ in. and 3 in. Both provide a strong, tight joint; easily disassembled.

Body—Made of high grade bronze which meets the A.S.T.M. Specification B-61. Heavy, rugged proportions and straight through full flow areas.

Double-Wedge Disc—Nickel alloy, ball and socket bearing; no internal wedge or pin. Discs readily adjust themselves to taper seats, insuring a tight valve.

Stay-On Discs—Will not drop off stem when assembling valve. Bevelled disc wing guides and body channels make assembly easy.

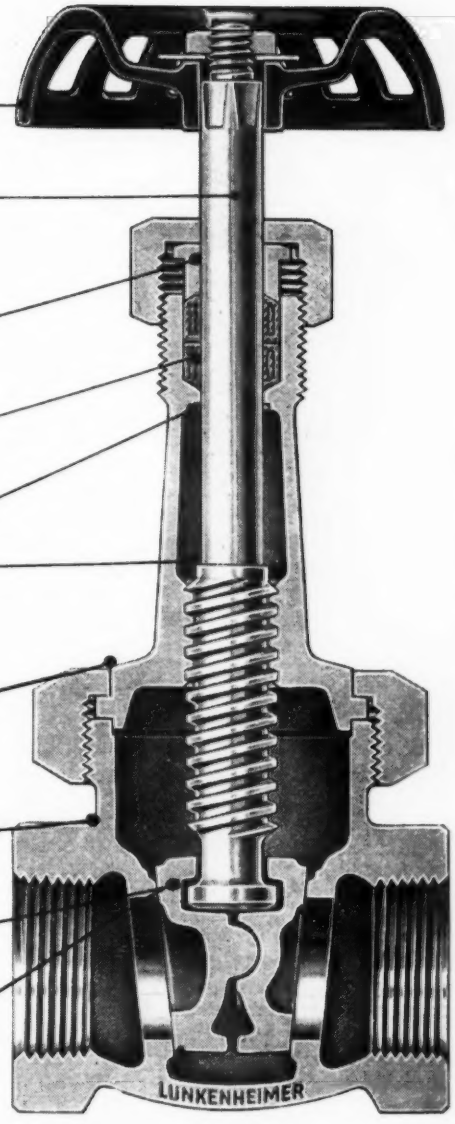


Fig. 2228

LUNKENHEIMER VALVES

Reliance helps you to comply with latest safety regulations

New operating chain handles for gage valves give sure guide to valve position

Furnished on all future shipments from factory —available at nominal cost to present users.

Now you can comply with the latest water gage regulation drafted for your protection. To further promote the safety of your boiler operation, you are required to use some means of indicating the position of water gage valves—whether *open* or *closed*. This applies to all gages whose lower valve is more than 7 feet above the floor or platform. You'll find the regulation on the A. S. M. E. pink addenda sheet covering Par. P-292 of the Power Boiler Code.

Your gage valves should be open at all times, unless closed temporarily for cleaning or repairs. Complete protection against water level accidents can only be exercised when your operators have a constantly visible check on one or more gages for each boiler. Reliance has promptly provided these new operating chain handles to identify closing and opening chains. When correct length chains are properly installed, the "open" handle should hang lower than the "closed" handle when valve is in open position.

The new "open" and "closed" operating handles designed by Reliance are now included with all shipments of chain operated water gages and water columns with gage equipment. Present Reliance users can obtain the handles from the factory at 50 cents per pair, postpaid in U.S.A. and Canada.

BOILER SAFETY DEVICES since 1884

Reliance

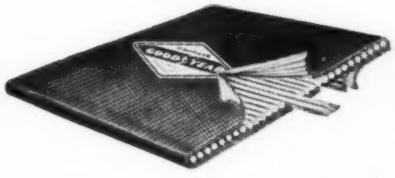
THE RELIANCE GAUGE COLUMN CO. • 5902 CARNEGIE AVENUE • CLEVELAND 3, OHIO

G-T-M-Specified

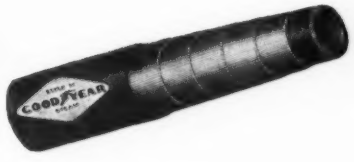
GOODYEAR INDUSTRIAL RUBBER PRODUCTS

TRIO OF PENNY-PINCHERS

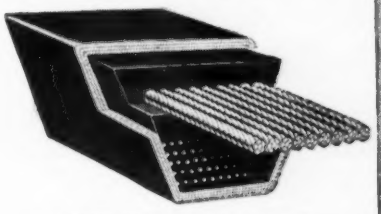
CUT COSTS WITH THESE MILL-PROVED GOODYEAR PRODUCTS



ENDLESS COMPASS BELTS, for compressors, generators, fans, line-shafts and other heavy-duty drives. In countless installations they have outlived and outperformed ordinary belts three and four to one.



STYLE M STEAM HOSE for all steam service up to 100 pounds' pressure. Tough, flexible construction with tube specially compounded to hold saturated steam. Tough cover to resist abrasion.



E-C CORD MULTI-V BELTS are uniform in length, cross section, pull and service life. Their perfect teamwork insures lowest ultimate cost.

WHEN it comes to delivering top-notch performance at rock-bottom cost, nothing in rubber compares with the famed Goodyear trio shown here. Each has established records for long wear and economy in all types of industrial use. And each is specified in the correct construction after careful appraisal of your requirements by the G.T.M. — Goodyear Technical Man.

For a firsthand report on the savings these star performers can bring to your mill, why not consult the G.T.M.? A line will bring him to your plant. Write: Goodyear, Akron 16, Ohio or Los Angeles 54, California.

FOR HOSE, BELTING, MOLDED GOODS, PACKING, TANK LINING, built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.

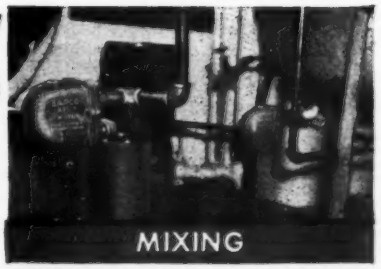
Compass, E-C Cord—T. M.'s The Goodyear Tire & Rubber Company

GOODYEAR

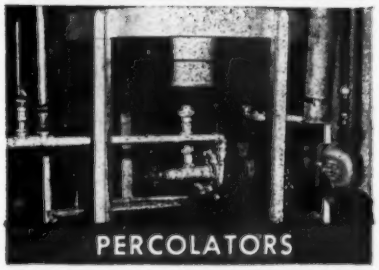
THE GREATEST NAME IN RUBBER

DISTILLATION

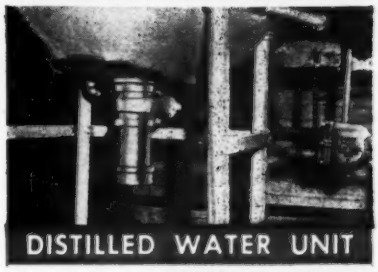
Flavors "FOR FOODS OF FAME"



MIXING



PERCOLATORS



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CRYSTALIZER

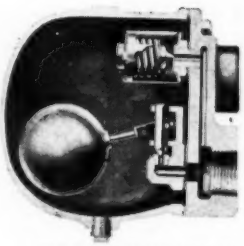
DISTILLING OIL

BLENDING

Every process requiring steam in the large flavoring plant of Food Materials Corporation, Chicago is provided with a Sarco Float-Thermostatic steam trap. The result is evidenced by the continuous, reliable production records and a quality output which faithfully reproduces the exact flavors originated in their extensive laboratories.

Wherever the cost of heat is a considerable proportion of the total cost of the product, it pays to put the right kind of steam trap on each coil and steam line. If temperatures must be held within a few degrees, it is comparatively inexpensive and easy to add Sarco Temperature Controls.

Information on the functions and uses of the various types of traps and control is given in the Sarco Catalogs sent on request. The nearest Sarco Representative will gladly cooperate in solving your individual process heating and cooling problems.



FLOAT-THERMOSTATIC STEAM TRAP

148

SARCO SAVES STEAM

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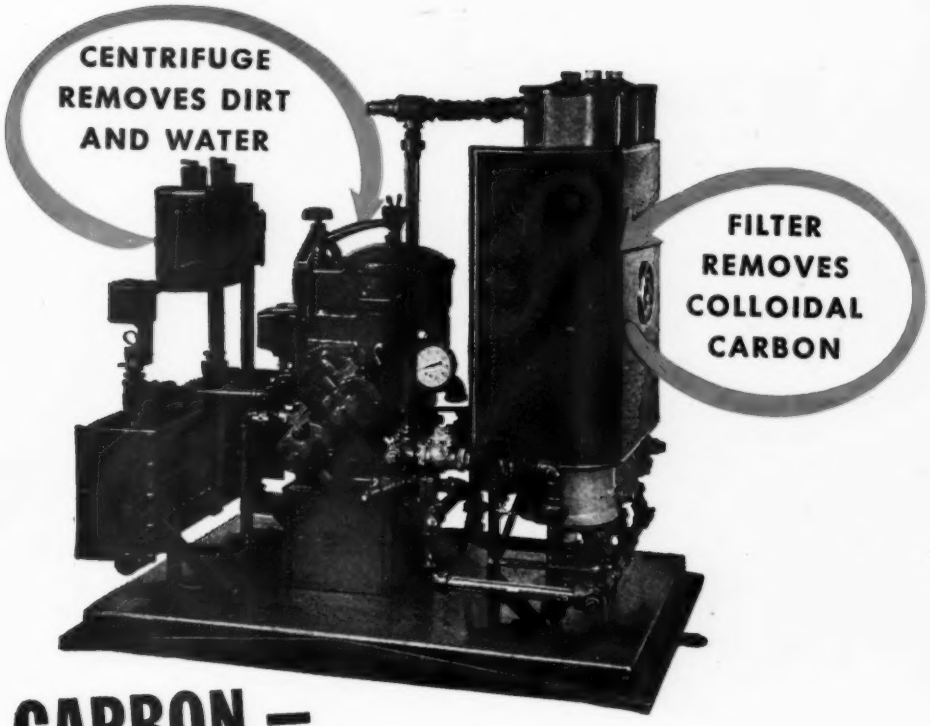


FOR OIL THAT'S CLEAN AND FREE OF COLLOIDAL CARBON—

The De Laval "Puri-Filter"

THE DE LAVAL "Puri-Filter" enables every Diesel operator to get a higher degree of purity in cleaning his Diesel lubricating oil than ever before. The De Laval "Puri-Filter" is a combination of a De Laval "Uni-Matic" Oil Purifier and two or more Fram "Filcron" Filters. The "Uni-Matic" rids the oil of dirt and water, and the filters take out the colloidal carbon.

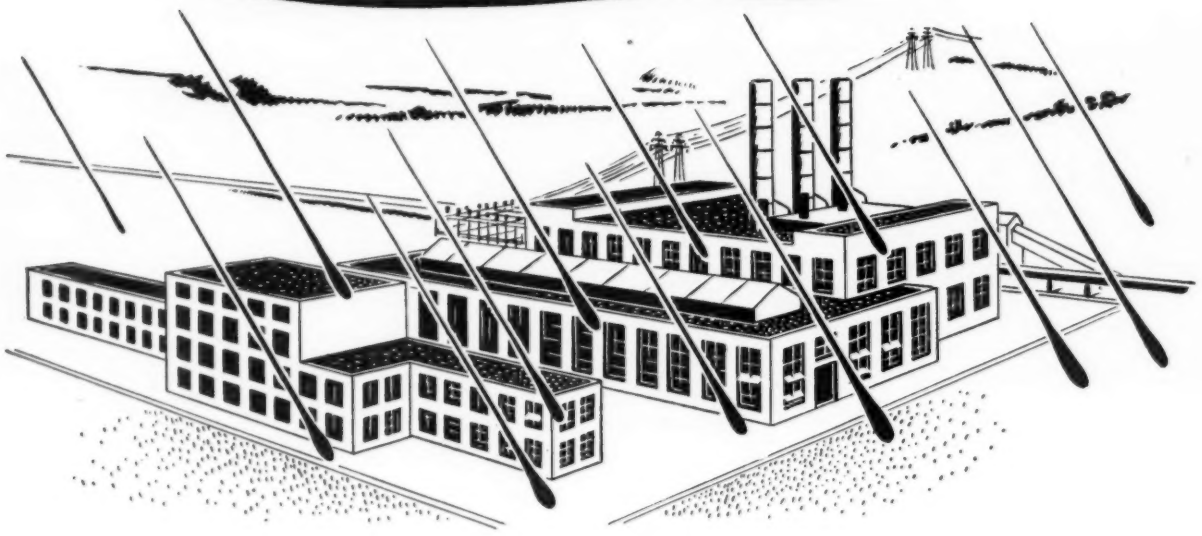
The De Laval "Puri-Filter" restores lubricating oil to a condition closely resembling new oil. It keeps the oil so clean, in fact, that crank case inspection, once one of the messiest jobs in power house routine, can usually be done without even soiling jumpers. This statement is vouched for by actual experience.

Bulletin DL-1 gives additional details on the De Laval "Puri-Filter". Write for your copy.

DE LAVAL
OIL PURIFIERS
FOR DIESEL LUBRICATING OIL

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

WHAT DOES RAIN COST YOU?



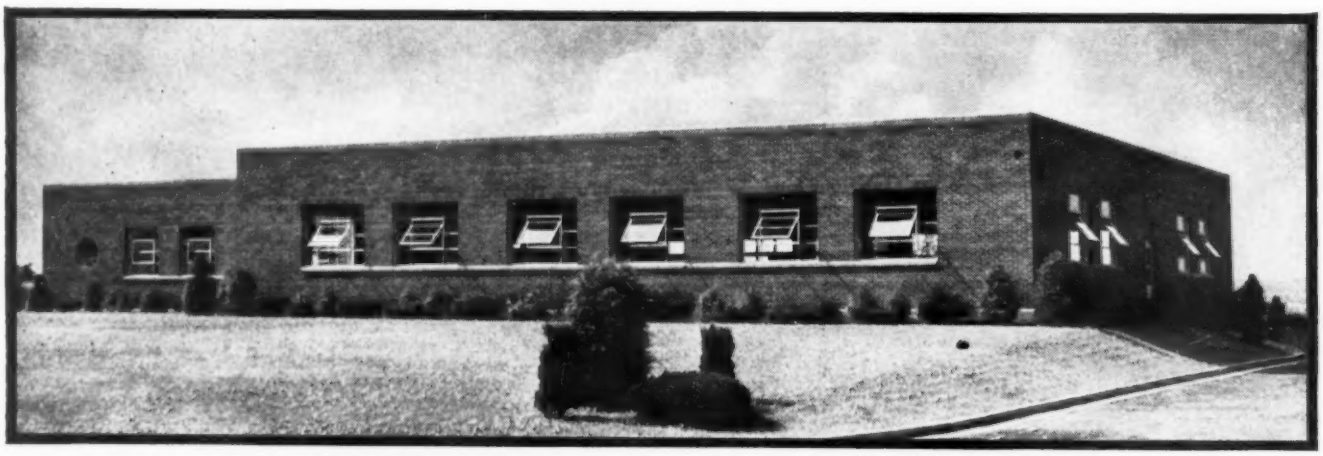
In an industrial neighborhood rain isn't just water. It picks up the sulphuric acid from soft coal smoke, the salts and fumes from chemical processes, and as it drives against your buildings, it seeks out the spots where rust and corrosion can start.

Look at your factory windows! Ordinary, light steel sash, especially if they have the conventional applied weatherings, offer an easy target where the forces of rust and corrosion make extra trouble and expense for you.

For lower cost in the long run, you'll be better off to install Hope's Lok'd Bar Steel Factory Sash in your factory buildings. Note on the next page the design and construction features that give these better windows their stouter defense against corrosion and their extra resistance to wear and tear.

Hope's Lok'd Bar Steel Factory Sash also are weathertight for life, saving you more money in fuel bills and giving your people greater comfort and contentment in their work.

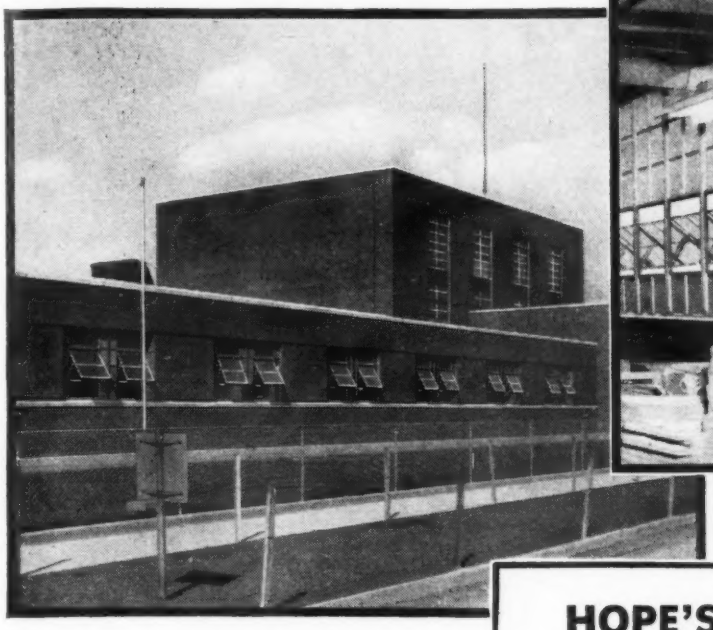
ASK YOUR ARCHITECT ABOUT HOPE'S WINDOWS

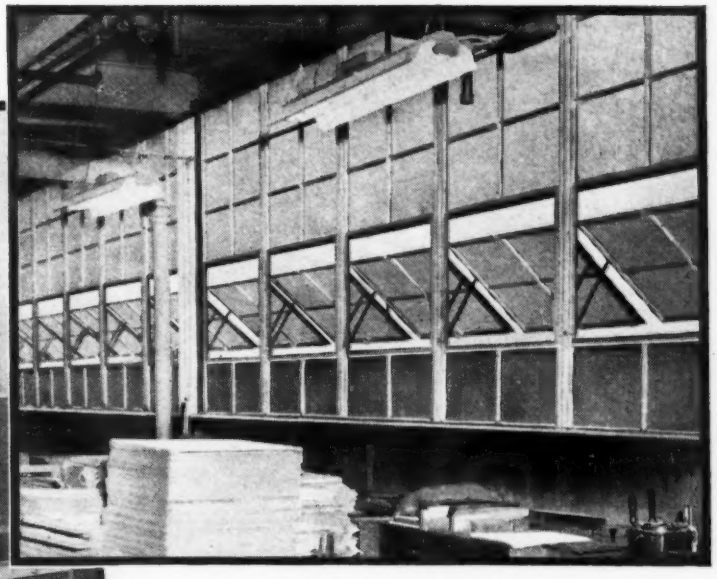


Coca-Cola Bottling Co., Jamestown, N. Y., Sherrill F. Lindquist, Architect

HOPE'S WINDOWS, INC., JAMESTOWN, N. Y.

Synthetic Yarn Bldg., Carbide and Carbon Chemical Corporation, South Charleston, W. Va.

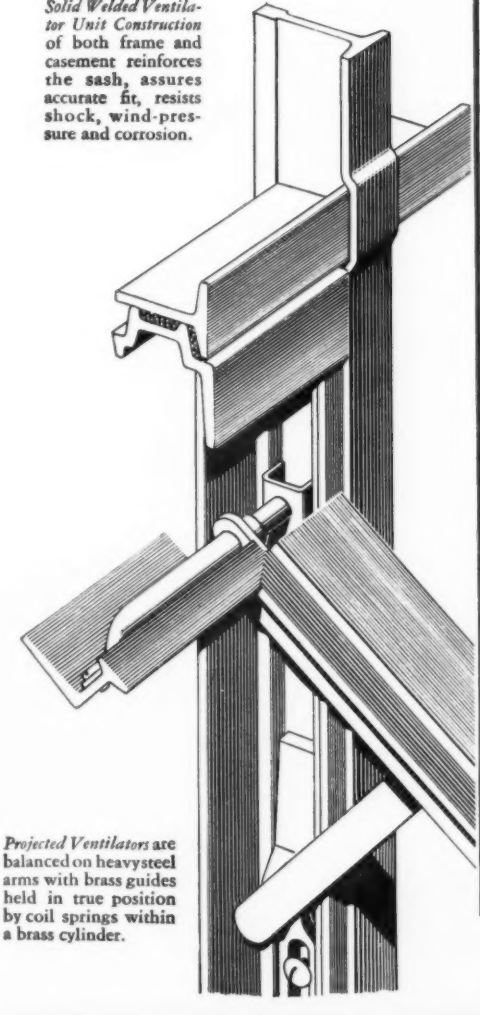




Hope's Lok'd Bar Steel Factory Sash, Fancher Furniture Co., Salamanca, N. Y.

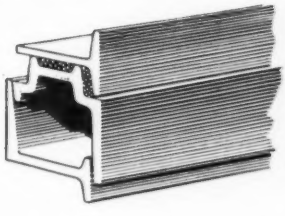
HOPE'S LOK'D BAR STEEL SASH
Design and Construction Features

Solid Welded Ventilator Unit Construction of both frame and casement reinforces the sash, assures accurate fit, resists shock, wind-pressure and corrosion.

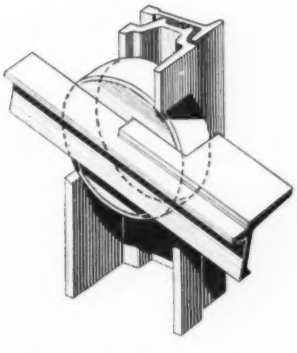


Projected Ventilators are balanced on heavy steel arms with brass guides held in true position by coil springs within a brass cylinder.

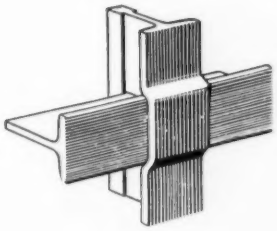
Strong, Heavy, Vertical Sash Bars . . . Bulb Tee Section Bars give greater strength for the weight of their metal; the starting point in designing a window that makes large glazed wall areas a safe and enduring construction.



Hope's Integral Ventilator Sections give broad, double, weathertight contacts all around the ventilators, reduce wind infiltration, increase weathertightness; no parts to work loose or rust away.



Solid Bronze Cup Pivots, stronger, neater, cannot stick or jam and are the only pivots which make perfectly weathertight joints.



Hope's Lok'd Bar Joint . . . Threading the flat tee horizontal muntin thru the vertical bulb tee gives sash more strength in proportion to steel used and least harmful distortion of metal.

MAIL THIS COUPON TODAY

Hope's Windows, Inc., Jamestown, N. Y. P-1047

Please send descriptive Literature featuring Hope's Windows in industrial installations.

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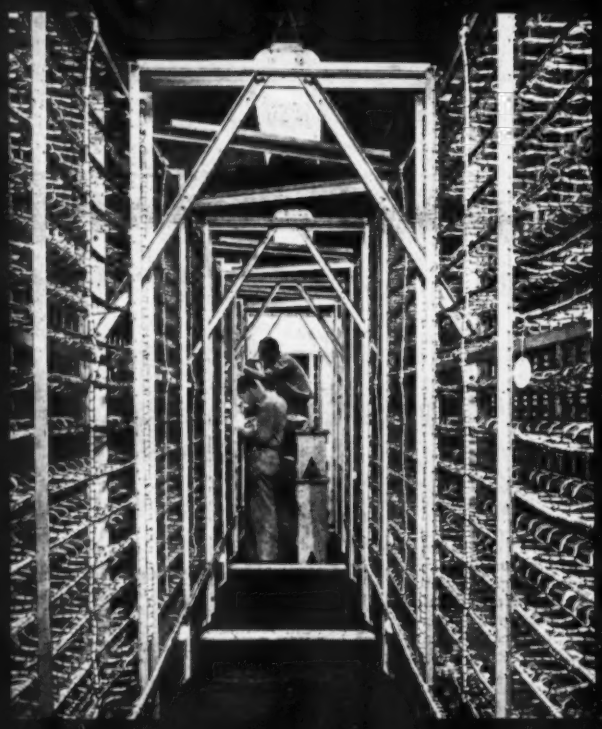
ELECTRIC "BRAIN"

IS WIRED WITH— DELTABESTON*



A million feet of Deltabeston wire is laced into the world's largest calculator, the Navy's Mark II, at Harvard University. Deltabeston wires carry information from one "brain cell" to another, from the time a problem is set up until solutions are reached.

Answers traveling along its intricate circuits have got to be right every step of the way. That's why Deltabeston wires were selected for this job.

Why is it that Deltabeston wires and cables are so often the choice for installations that need something extra in wiring protection — where the emphasis is on doing jobs right? Above all, it's Deltabeston's well-chosen insulation — designed in a full range of styles to beat ambient heat and conductor heat for installations of all types. In addition, Deltabeston's flexibility makes it easy to handle, easy to work with on intricate jobs, without injury to insulation. And features like toughness, abrasion resistance, and moisture resistance help make it the choice for tough jobs. For unusual jobs, there are wires and cables with special features in the complete, heat-beating Deltabeston line.

Let us send you information on beating your heat problems with Deltabeston wires and cables. Write to Section Y91-1063, General Electric Company, Bridgeport 2, Connecticut.

*Trade-mark Reg. U. S. Pat. Off.

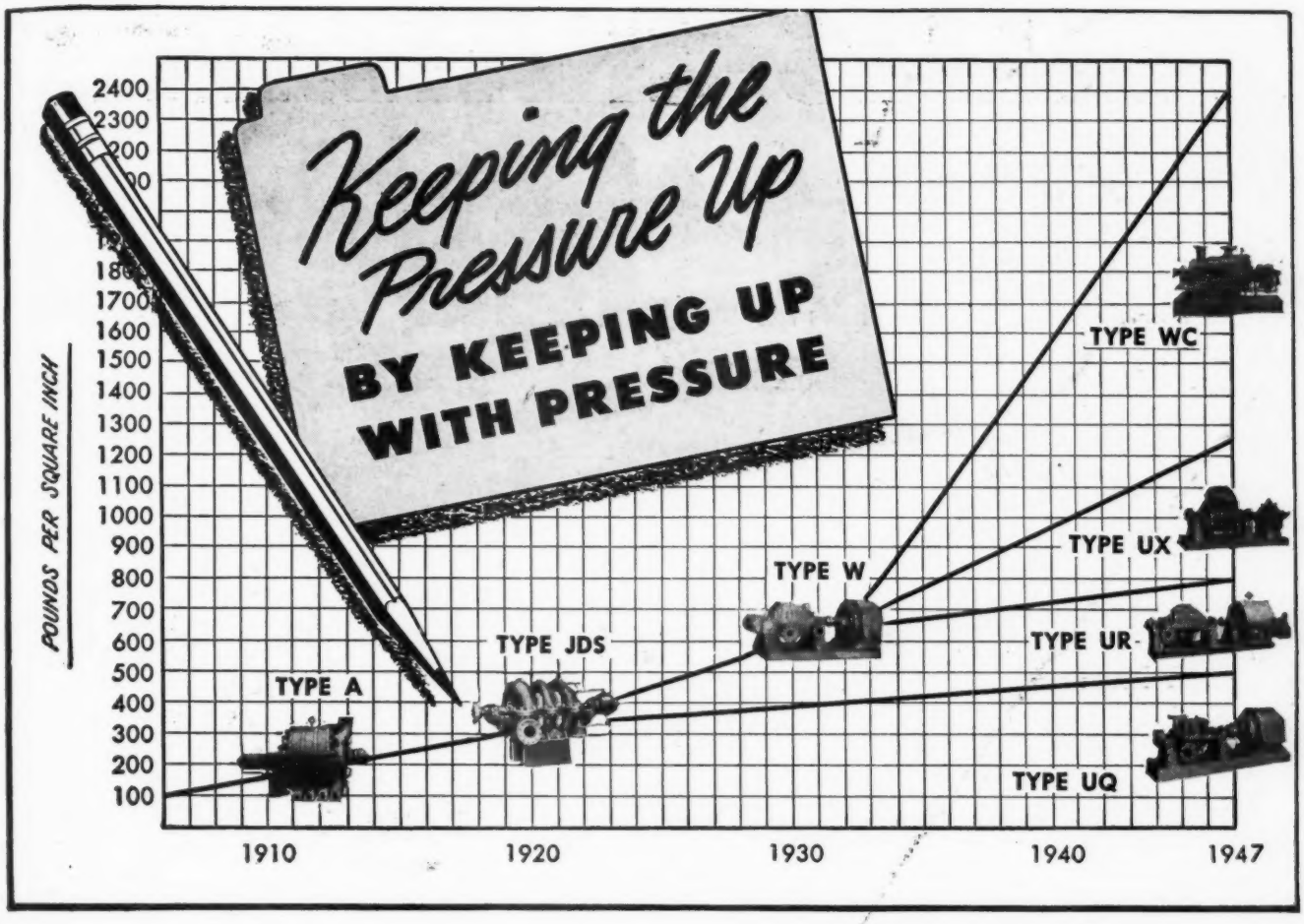
DELTABESTON

wires and cables

Silicone-treated cables • aircraft wires
hook-up wires • power cables
appliance wires • fixture wires and cords
magnet wires • locomotive cords

built to beat the heat

GENERAL ELECTRIC



The graph shows you how closely Worthington has kept pace with industry's demands through the years . . . by developing centrifugal pumps to handle steadily mounting boiler feed pressures.

It's a record of steady progress . . . from the old Type A, a great performer at 200 psi . . . to the powerful modern Types WC, UX, UR and UQ, with pressures ranging from 2½ to 12 times the 1910 "ceiling".

THE LONGEST AND BROADEST EXPERIENCE

In addition, out of Worthington's more than 100 years of pioneering in pump design and manufacture have come such notable improvements as the Elastic Seal Ring for tight interstage joints in axially split-case pumps . . . the Metal-to-Metal Ring Type Joint in solid-case barrel pumps.

FOR YOUR OWN BOILER FEED REQUIREMENTS

Worthington has the most complete line of centrifugal pumps — all pressures, all capacities — and engineers trained to fit feed pump to feed cycle for maximum economy and dependability.

For details that prove *there's more worth in Worthington*, contact our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

WORTHINGTON

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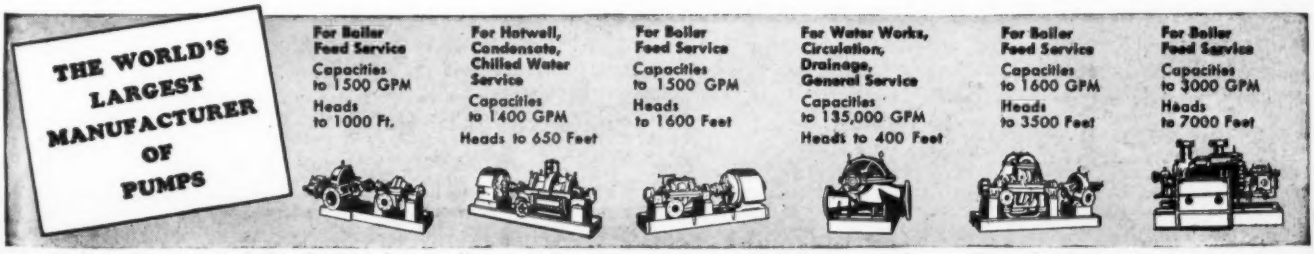
THE WORLD'S LARGEST MANUFACTURER OF PUMPS


For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Hotwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 650 Feet
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1600 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3500 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet

ALLIS-CHALMERS

Pre-Engineered

COMPLETE AUTHORITATIVE PRACTICAL

— ONLY ALLIS-CHALMERS OFFERS YOU THIS ADVANCED ENGINEERING

THIS IS the most complete V-belt drive reference book ever published. It contains:

PRE-ENGINEERED DRIVE TABLES—1 to 150 hp, thumb-indexed for quick reference. Just turn to the page you want — read off the complete drive data.

ENGINEERING TABLES — sheave dimensions — drive selections — general information. Everything carefully arranged and indexed for easy figuring of special drives.

Book contains 144 pages, size 8½ by 11 inches. Thumb index and classified index make it easy to use.

ANNOUNCES
Texrope Drives

..and a NEW Texrope Manual that Makes Selection Easy

THIS MANUAL marks a revolutionary advance in the application of V-belt drives. It enables every user to select, with unerring accuracy, the one *best* drive for any normal requirement. It eliminates guesswork, figuring and chance for error. It assures greatest possible economy and efficiency in the use of Texrope V-belt drive equipment.

SOLVES 90% OF ALL V-BELT DRIVE SELECTION PROBLEMS

Texrope Pre-Engineered stock drives tables have been worked out in a complete range of speeds, for horsepowers from 1 to 150. These tables show, in one place, the correct drive for any requirement. Each is the *one best drive* for the job, as pre-engineered by the finest V-belt engineering staff in the world.

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Every Pre-Engineered drive selection is made up of regular Texrope stock items. No special-order equipment is required. You can't make the mistake of buying a larger, more expensive drive than you really need, or of installing an underpowered drive that will be costly in performance and maintenance. Texrope Pre-Engineered drive selections are the *best* engineered drives — in low first cost — in performance—in reduced maintenance.

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Only Allis-Chalmers has developed a complete Pre-Engineered drive manual. It is more than the work of slide-rules or the rearrangement of old tables. It includes the industry's greatest V-belt drive experience—the knowledge and judgment gained through 22 years of building and studying V-belt drives for every industrial application.

Copies of this new manual have been sent to many Texrope users and dealers. If you have not received one, write for Texbook No. 20P40. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2249

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"Super 7" V-BELTS
Five Types — Sizes to suit every power transmission job.

Texsteel, Texdrive, "Magic-Grip"
— sheaves in a full range of sizes, grooves.

"Vari-Pitch" SHEAVES
Exact variations in speed, stationary or motion control.

SPEED CHANGERS
Speed variations up to 375% at the turn of a crank.

ENGINEERING
Finest V-Belt engineering talent in the world—at your call.

TEXROPE "Super 7" V-Belts result from the cooperative research of two great companies — Allis-Chalmers and B. F. Goodrich. They are sold only by A-C.

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

1847 1947 A CENTURY OF SERVICE to Industry THAT MADE America Great

TIME
...measured in service and performance!

No one can say how long a time, measured in days, months or years, a certain valve will give satisfactory performance. Naturally it will depend on the service conditions—how much the valve is operated and especially the kind of media it controls.

But we can say positively that a valve of absolutely correct design and materials for the conditions under which it operates will last far longer and require much less maintenance than a valve which does not fully meet these requirements.

That's the kind of valves you get when you standardize on the Powell Line for all your flow control requirements. Because through more than a century of making valves—and valves only—Powell has concentrated on developing a complete line of valves—in bronze, iron, steel and the widest range of corrosion-resistant materials ever used in making valves—to meet every requirement of modern industry.

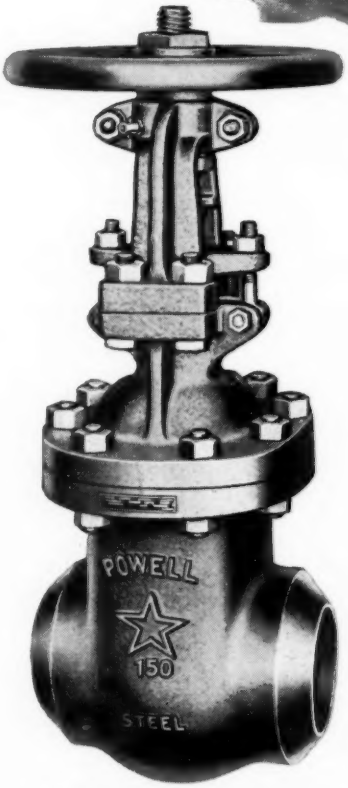


Fig. 1503 W. E.—Class 150-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc.

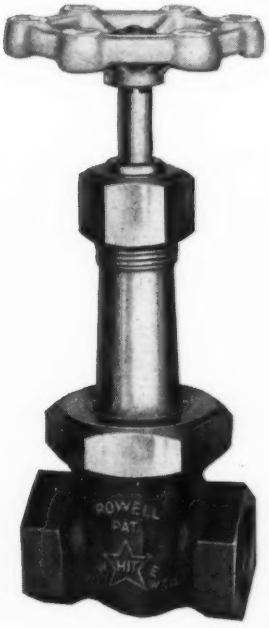


Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet, and renewable, wear-resisting "Powellium" nickel-bronze disc.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati 22, Ohio

POWELL

Fig. 1365 W. E.—Class 1500-pound Cast Steel Horizontal Lift Check Valve with welding ends and bolted flanged cap.

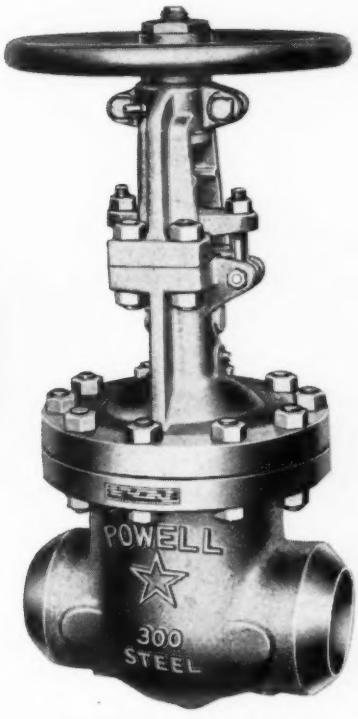


Fig. 3003 W. E.—Class 300-pound Cast Steel Gate Valve with welding ends, outside screw rising stem and bolted flanged yoke.

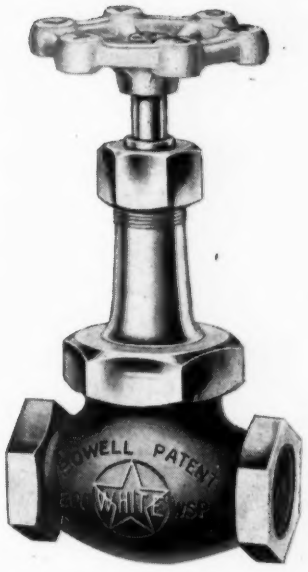


Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze disc.

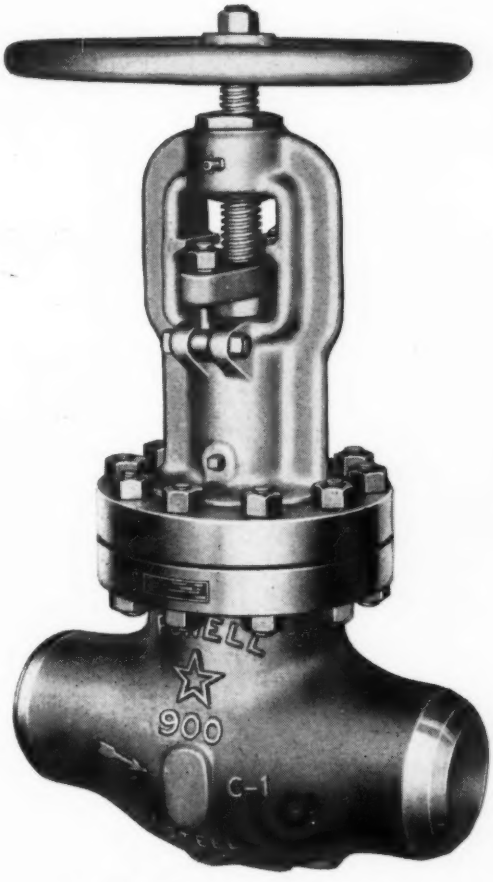


Fig. 9026 W. E.—Class 900-pound Cast Steel Globe Valve with Piston Guided Disc. Welding ends, bolted flanged yoke and outside screw rising stem.

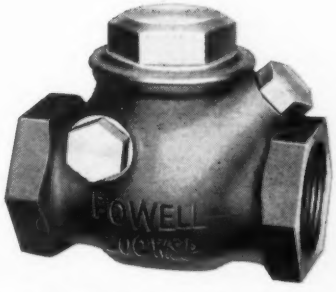


Fig. 560—200-pound Bronze Regrinding Horizontal Swing Check Valve. Has screwed ends, screwed-on cap and regrindable, renewable bronze disc.

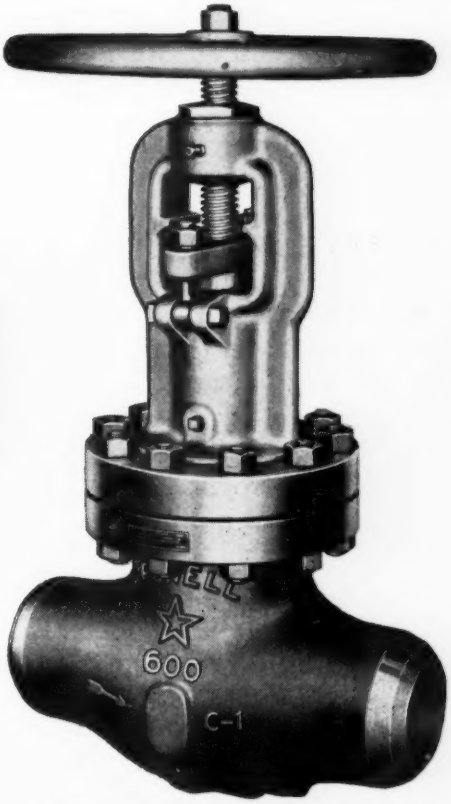
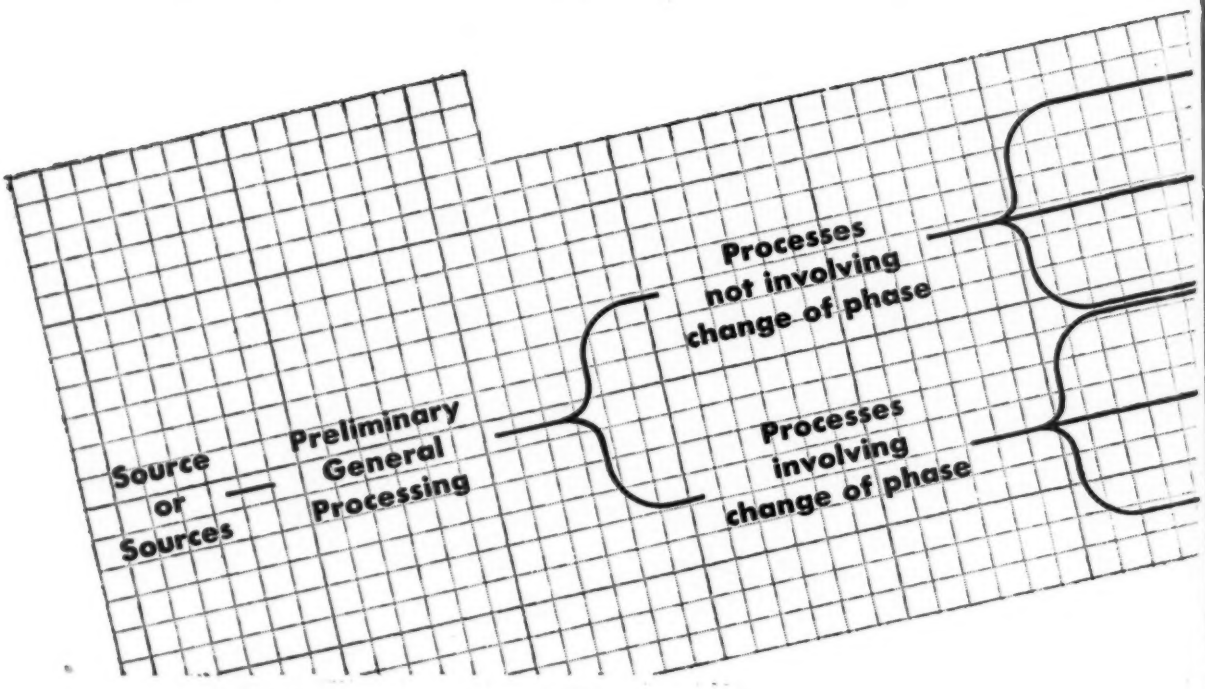


Fig. 6031 W. E.—Class 600-pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke.

VALVES


Source or Sources
Preliminary General Processing
Processes not involving change of phase
Processes involving change of phase

What Hall service

When procedures for water treatment have been set up in your plant, and your personnel trained in the routine tests necessary to maintain proper conditions—Hall *service* has just begun.

Thereafter, Hall field service men visit your plant at regular intervals, and the laboratory at Pittsburgh regularly checks samples of your feed water and boiler water. In this way, conditions which might cause trouble are detected before they become serious. Among Hall clients, the typical case history is one in which nothing happens.

When trouble does arise, field men, laboratory, and home office technicians join forces to trace the trouble to its source and show you how to correct it. The problems which must be solved in this "trouble shooting" are extremely varied, and it is interesting to note that *80 per cent of all troubles prove to be due to factors other than water.*

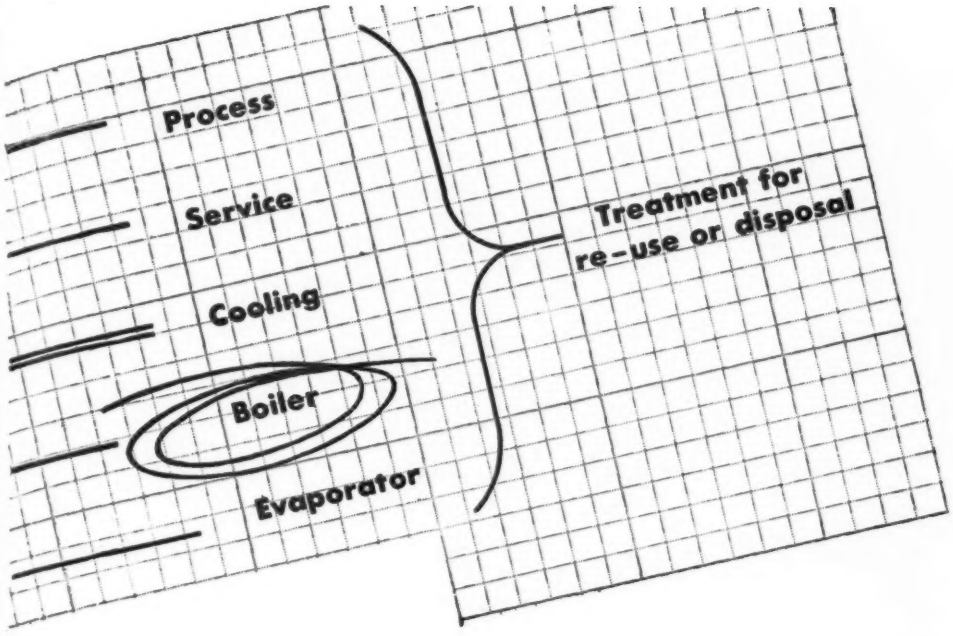
Here are some typical cases from our files:

CASE I: The "symptom" here was unusually high consumption of sodium sulphite. Since the Hall engineer knew that this is frequently a sign of oxygen contamination, he started to check possible sources, and found appreciable oxgen at the pump suction while there was zero dissolved oxygen at the heater discharge. Following this clue, he discovered that undeaerated condensate could leak from a return line through the equalizing line to an idle pump, and thence into the suction of the operating pump. The whole problem was solved by merely shutting the valve in the pump suction line to the idle pump.

CASE II: Corrosion of turbine blades was blamed on carry over of chloride from the boiler water. Testing the steam proved that no chloride was present, hence corrosion must be occuring during stand-by. Examination of the turbine system showed that the leak-off connections on the carbon seal rings ended below the level of salt water in the hot well. There was no check valve on the line, so when the turbine was shut down, the line became a siphon, drawing salt water from the hot well into the turbine.

CASE III: The first sign of trouble in this plant was failure of a superheater tube. Analysis of the scale in this tube showed that carry over was taking place. This was corrected, but deposit continued to collect on the turbine strainer and eventually clogged the steam line.

The Hall field engineer brought the problem



means to you

to the home office, where the staff explored the whole situation and decided that the key to the problem lay in the nature of the deposit. This proved to be 90% sodium sulphite and sulphate. Since sodium sulphite was being added to the boiler feed water, it was evident the feed water must somehow be getting into the steam line.

Study of the piping diagram, which was in the files dealing with this plant, showed only one place where leakage could possibly occur—through an excess pressure regulator. The Hall engineer went back to the plant; the regulator was found to be of an old type and somewhat worn; it was replaced, and the trouble stopped.

CASE IV: Tubes frequently cracked circumferentially, where they were rolled into the tube sheet. Before a remedy could be prescribed it was necessary to know whether this was due to corrosion fatigue or to embrittlement. Metallographic examination gave the answer; photomicrographs made by Hall Laboratories revealed fine cracks definitely intergranular in character—clear evidence of embrittlement. Thus, the remedy was the application of treatment to make the boiler water non-embrittling.

Every plant that generates its own steam can profitably use Hall boiler water conditioning service, but the work of Hall Laboratories is not limited to boilers. Every problem concerning the use of water in industry comes within the scope of its activities. Correspondence concerning such problems is invited.

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

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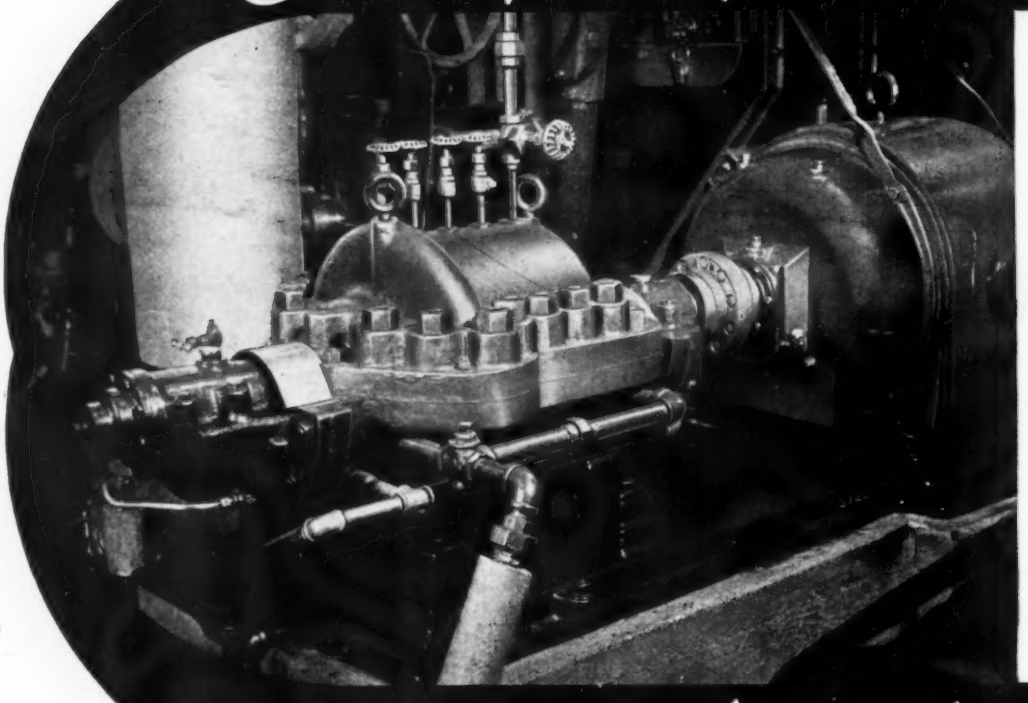
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

Hardly a sign of wear...



...after 45,000 hours of service

Can you match this record?

This relatively small boiler feed pump, delivering 250 gpm against 513 psi, required no replacement parts or reconditioning after 45,000 hours of service.

THE EXCELLENCE OF DE LAVAL design and construction is demonstrated by the performance of a De Laval boiler feed pump recently inspected after 45,000 hours of service in the municipal power plant of the City of Wyandotte, Michigan.

The following paragraph is quoted from the inspector's report:

"All machined surfaces of the case are in original condition. Diaphragms and balance arrangement fit neatly in all bores. Horizontal joint has no indication of leakage. Faces of rotating and stationary balance plates are in good condition; wear is approximately .005". Shaft sleeves are highly polished but are not worn or grooved. There is no leakage between shaft sleeve spacers and wheels. The shaft has no indication of contact with water. Wheel wearing rings show no indication of wear. No new parts were used in reassembling."

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OCTOBER 1947

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A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
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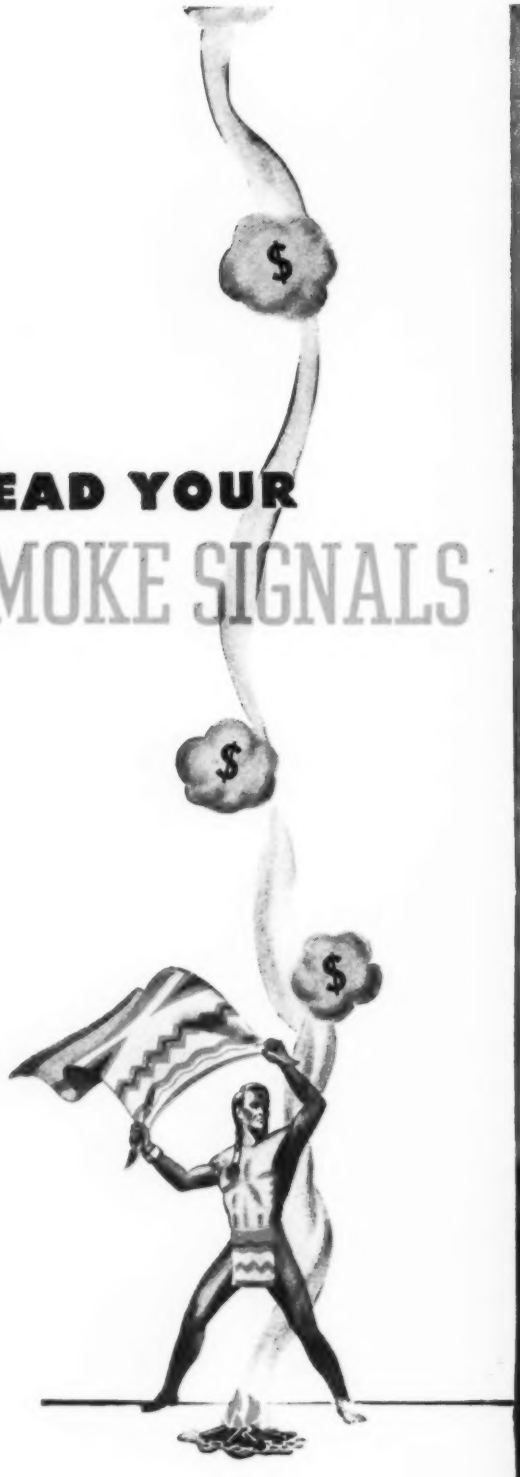
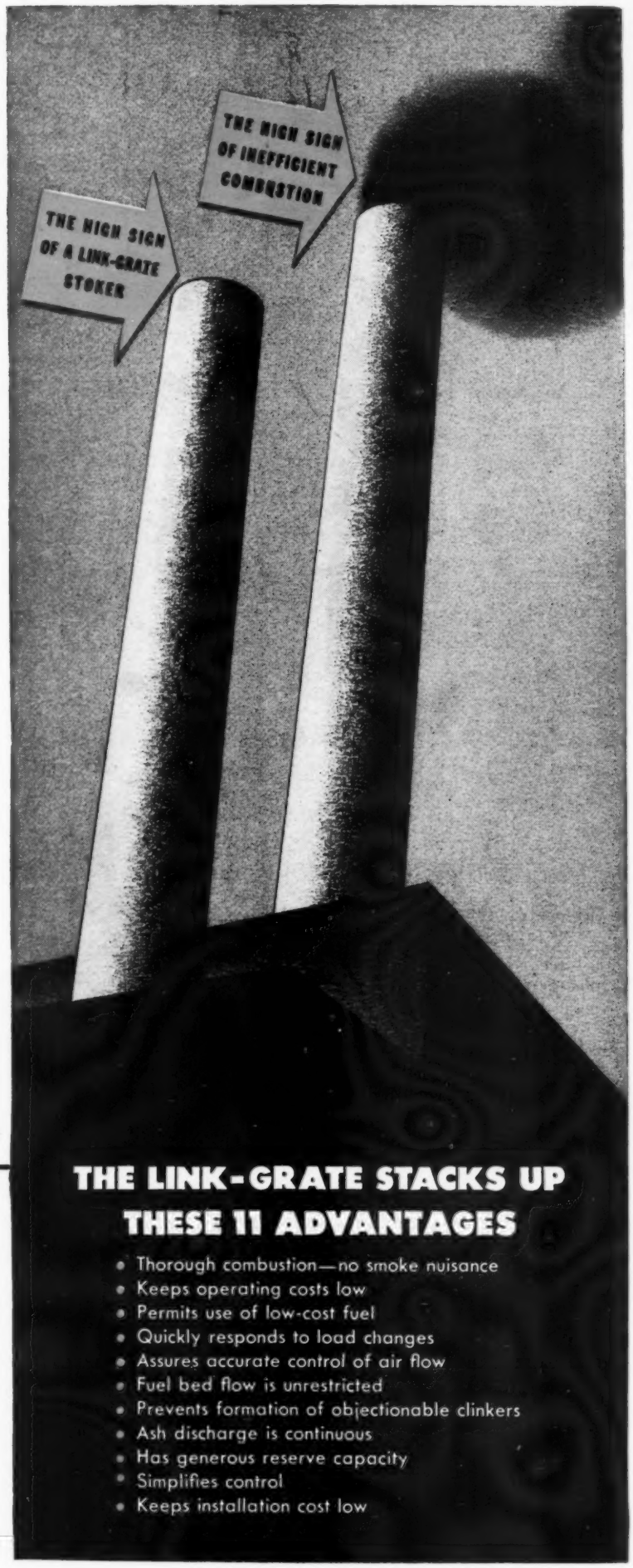
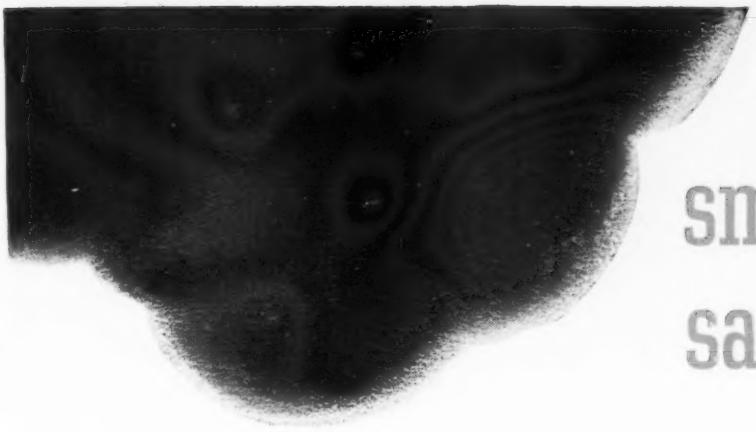


READ YOUR
SMOKE SIGNALS

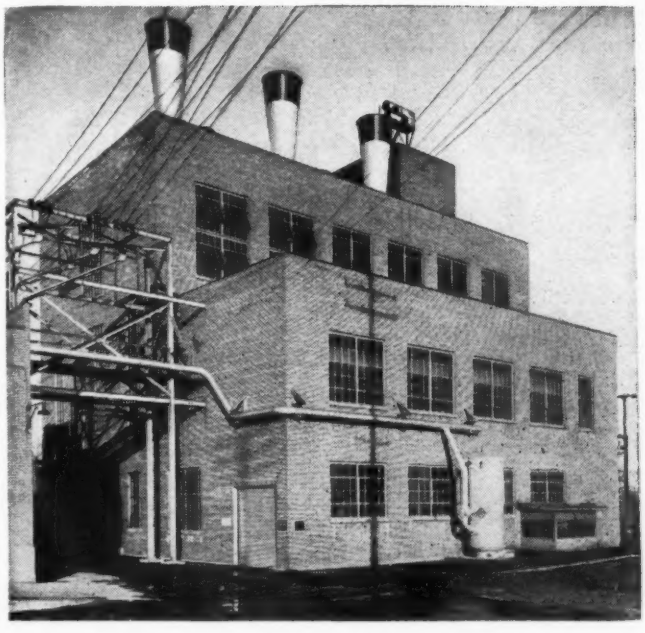


THE LINK-GRATE STACKS UP
THESE 11 ADVANTAGES

- Thorough combustion—no smoke nuisance
- Keeps operating costs low
- Permits use of low-cost fuel
- Quickly responds to load changes
- Assures accurate control of air flow
- Fuel bed flow is unrestricted
- Prevents formation of objectionable clinkers
- Ash discharge is continuous
- Has generous reserve capacity
- Simplifies control
- Keeps installation cost low



smoke abatement saves you $ $ $ $



Note the almost negligible amount of smoke from the stacks of this International Harvester Company plant at Springfield, Ohio, where 6 retort SDL 36 Link-Grate Stokers are used to fire boilers with 60,000-pound steam capacity. (Photograph is not retouched.)

Smoke abatement means more coal burned . . . less coal "up the flue" as soot . . . and more steam per pound of coal. With a Westinghouse Link-Grate Stoker, you get these advantages and many more—as has been proved in dozens of installations from coast to coast.

The Link-Grate action maintains a regular combustion rate by continuously processing the fuel bed to keep it porous. With this action, a positive motion at the rear of the stoker permits a uniform flow of coal over the underfeed section to keep the burning lanes open.

In Link-Grate action, the grates first hinge upward to break open the fuel bed and let low-pressure air flow through the grates. The reverse movement of the grates crumbles and conveys the burning fuel.

This conveying movement of the Link-Grate keeps the ash coming continuously off the discharge plate. This does away with periodic dumping and reduces labor. Clinkers are not a problem.

Since the fuel bed is always porous, the Link-Grate Stoker can meet suddenly increased steam demands quickly with full combustion efficiency.

Get the complete information about the Link-Grate before you make an investment in stokers. If possible, see one in operation. Your nearest Westinghouse office will be glad to arrange an appointment with a user. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50471

Show Link-Grate Movies in Your Own Office. A 15-minute sound moving picture has been produced to show in detail the operation of a Link-Grate Stoker. Whether you can visit an actual Link-Grate Stoker in operation or not, this interesting 16 mm film will show you its action and explain its points of superiority while you sit at your desk. To borrow a print of this film for your own private showing, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

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Link-Grate STOKERS

Designed to increase flow and to reduce maintenance

BYERS WROUGHT IRON PIPE

Smooth sweeping curves make this paint spray piping layout a real work of art . . . but they have a very practical function, too. The absence of sharp bends and of fittings means unimpeded, low resistance flow, and no pockets to entrap and hold material. Practical considerations also dictated the choice of piping material, which is Byers Wrought Iron. The unusual corrosion resistance of wrought iron makes it a favored material for a wide variety of responsible jobs.

The installation was made in an automobile assembly plant at Kansas City, Kansas. The pipes shown are duco spray lines at a body booth and are a part of a Binks Circulating System. E. W. Lochman Plumbing and Heating Company of Kansas City, Missouri handled the piping installation.

Providing and maintaining process piping is a complex job, because of the variety of fluids that must be handled. Whenever corrosion is a factor, Byers Wrought Iron deserves careful consideration. Its unusual structure and composition—tiny fibers of glass-like silicate slag threaded through a body of high purity iron—halt and "detour" corrosion, and also help to anchor the initial protective scale, which shields the underlying metal. You can get an idea of its widespread use from our bulletin, "Wrought Iron for Piping Systems." Ask for a copy.

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POWER

PHILIP W SWAIN, EDITOR • OCTOBER 1947 • ESTABLISHED IN 1882

Manpower vs Horsepower

WE ALL KNOW that power is an essential element in producing the many and varied goods and services that go to make up our national income. Yet most of us, if asked, would be at a loss even to guess how many horsepower hours it takes to produce a dollar's worth of that national income. As it happens, there isn't any need to guess, because the Twentieth Century Fund has the answer, and it's one of real interest to power engineers.

The monumental survey sponsored by the fund—*America's Needs and Resources*, by J Frederic Dewhurst and associates—reveals the relation of work energy to national income in a single, illuminating chart. This shows that, since 1850, national income has multiplied 27-fold and that energy use has increased at nearly the same rate. This refers to total energy derived from the efforts of men and animals and from coal, oil, gas and water power, used to turn wheels in industry, transportation and the home.

In 1850, virtually all work was done by men and animals—today virtually all is done by power produced from fuels and falling water. In less than 100 years, a more than 300-times increase in use of these energy resources has revolutionized the entire pattern of production.

The same chart shows another interesting fact. The amount of energy used *per dollar* of national income (adjusted for price-level changes) has remained essentially constant at from two to three horsepower hours, displaying no definite trend either up or down. Being familiar with statistics showing growths, improvements in efficiency and other signs of real or fancied progress, we are apt to find this fact disappointing at first blush. Why should we need as many horsepower hours to produce a dollar's worth of goods and services today as we did almost 100 years ago?

If we think about it, we can see that this is, after all, about what should be expected. Although the uses of power defy cataloging, we know that a major share goes to moving or lifting things and persons, and changing the shape of metals and other materials by cutting, forging, grinding, crushing, etc. To a considerable extent, power required for these operations depends on natural laws and there is little we can do to change it. We can reduce frictional losses in a hoist to the vanishing point, but it's still going to take a horsepower hour to raise a 10-ton load 100 feet. No matter how much we improve the machinery, grinding a pound of cement or flour needs an essentially fixed amount of energy, just as does removing a given weight of metal in a lathe or miller.

Thus it might be said that somewhere there is an irreducible minimum of power use in the many activities supplying human wants. Certainly we have closed in on this minimum point, and our modern machines utilize the energy supplied them far more efficiently than those of the past. This being so, one might well ask what has happened to the saving. Much of it has been expended in other ways. For example, many industrial operations now take place in air-conditioned buildings and the machinery for producing controlled climate absorbs power.

What does all this mean to the power engineer? First, he can take deserved pride in knowing that his art has released men and animals from the back-breaking toil of past centuries. Second, the power he has poured into our production machinery has made possible a national income, and hence a standard of living, vastly higher than any possible to a civilization depending on men and animals for energy. Finally, he can be assured of a continuing key position in the national economy. As long as every dollar of national income requires an essentially constant input of energy for its production, the nation's people will depend on him for the greater volume of goods and services they will want for an ever higher standard of living. Truly, *every economic and social change in this country, or in this world, demands more power to implement the change.*

Power of Twenty Million Horses Flows Down the Columbia River

The river's vast resources are a major factor in Pacific-Northwest economy, and to a degree the U. S. and Canada. Here's a plan to install 20-million-hp capacity, generate 65 billion kwhr, irrigate 5.4 million acres at a cost of 5.6 billion dollars

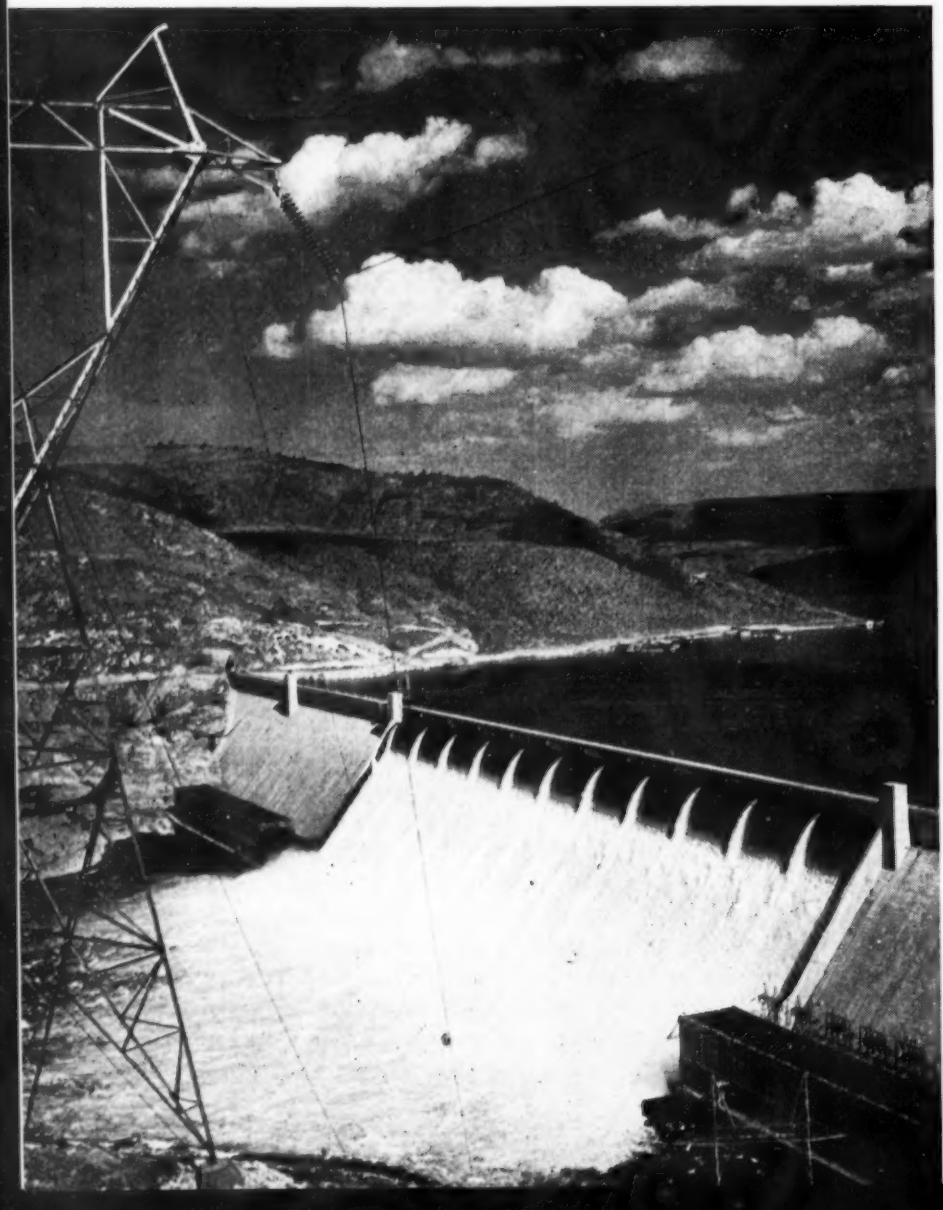
▶ TREMENDOUS VOLUMES of water falling from high elevations to the sea make the Columbia River and its tributaries one of the world's great sources of hydroelectric power and water. To show how vast its resources are, let's look at a 1947 report* to Congress for development of the Columbia basin within the U. S.

The program calls for flood control, irrigation, navigation, power development, water conservation, silt control, and pollution-abatement projects by several federal agencies in Washington, Oregon, Idaho, Montana and Wyoming. It proposes development of 238 projects over many decades at a cost of $5,600,000,000, installation of over 13,000,000 kw (19,000,000 hp) of new capacity, and generation of 65,000,000,000 kwhr annually. Before considering power developments here is a brief summary of some geographic features.

Geographic Setup. The Columbia rises in British Columbia in Lake Columbia, 2652 ft above sea level, west of the Continental Divide. It flows north for 195 miles, as the map on p 66 shows, makes a sharp 180-deg. turn westward, then flows south 270 miles into the northeast corner of Washington. Continuing in a southerly direction to the Oregon state line, it makes a 90-deg turn and flows westward to form the boundary between Washington and Oregon, then empties into the Pacific.

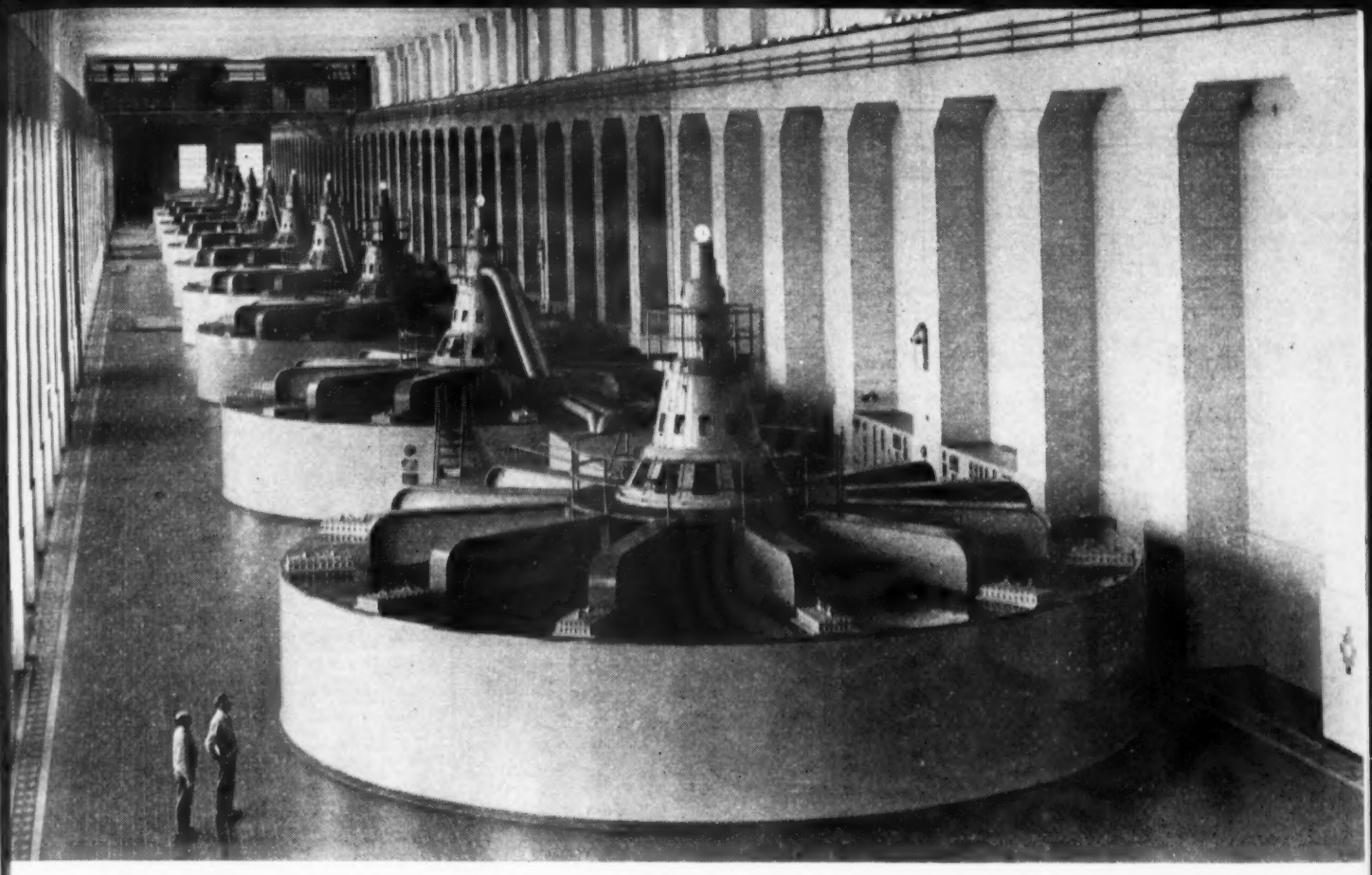
This 1215-mile river falls 1360 ft in its 465-mile Canadian section, and 1290 ft in its 750 miles in the U. S. Its main tributary, the Snake River, rises in Yellowstone Park, nearly 10,000 ft above sea level, and flows nearly 1100 miles in a northwesterly direction to join the Columbia near the Oregon border.

Most of its other hundreds of tributaries rise 3000 to 9000 ft above sea level in mountainous areas where precipitation is heavy. The thick forests, which cover these high elevations, together with slow melting of heavy snow fields and vast glaciers, help regulate runoff to provide in large streams the water needed during summer. Many lakes also store water to help regulate flow and contribute toward making the



GRAND COULEE POWER PLANT has installed 1,018,000 hp in six 165,000 hp main units and two 14,000-hp service machines. Six more 165,000-hp units are on order or being installed. Completed capacity will be 3,012,000 hp in 18 main and 3 station-service units

* This report is one of a series on Western river basins being prepared by the U. S. Bureau of Reclamation, U. S. Corps of Engineers, Federal Power Commission, Dept of Agriculture, and various agencies of the Dept of the Interior.



BONNEVILLE PLANT at tidewater on the Columbia River has an installed capacity of 724,000 hp in ten units under a 60-ft head, has been loaded to 770,000 hp. It is a combination hydroelectric power generation and navigation development

river system the great source of water and power that it is.

The Columbia basin drains 259,000 sq mi, which includes 39,700 sq mi in southeastern British Columbia, almost all of Idaho, most of Washington and Oregon, western Montana, and a small part of Wyoming and Nevada. This area equals that of Germany and Holland combined, which supported a population of nearly 100,000,000 before the war, compared to about 2,500,000 in the Columbia basin.

Above the site of Grand Coulee Dam the river drains 74,100 sq mi, and its flow normally varies from 17,000 to 492,000 cfs, amounting to a runoff of 80,000,000 acre-ft. In the flood of 1894, flow reached 725,000 cfs. At Bonneville, which is at tidewater, flow has a normal range of 43,000 to 800,000 cfs with a peak of 1,170,000 cfs in 1894. The Columbia discharges into the sea an average of nearly 160,000,000 acre-ft of water annually—more than any other river in the U. S. except the Mississippi.

Long-time Development. The huge undertaking of developing these water resources will require many years. Completion of the 238 projects in the plan will provide irrigation water for 5,360,000 acres of land, including 3,840,000 acres not now irrigated. Diking and drainage works will increase the utility of 565,000 acres additional. These developments will provide from 50,000 to 70,000 new farming opportunities. The nearly 200 power plants will have an installed capacity of 15,000,000 kw (20,000,000 hp). This does not include the power that can be developed on the Columbia, Fraser and Thompson Rivers in British Columbia, nor that on the rivers in western Washington and Oregon outside the Columbia basin. When these power sources are included we have upward of 35,000,000 hp that can be coordinated into a gigantic system covering an area of about 400,000 sq mi. Few areas in the world of comparable size have such vast hydroelectric possibilities.

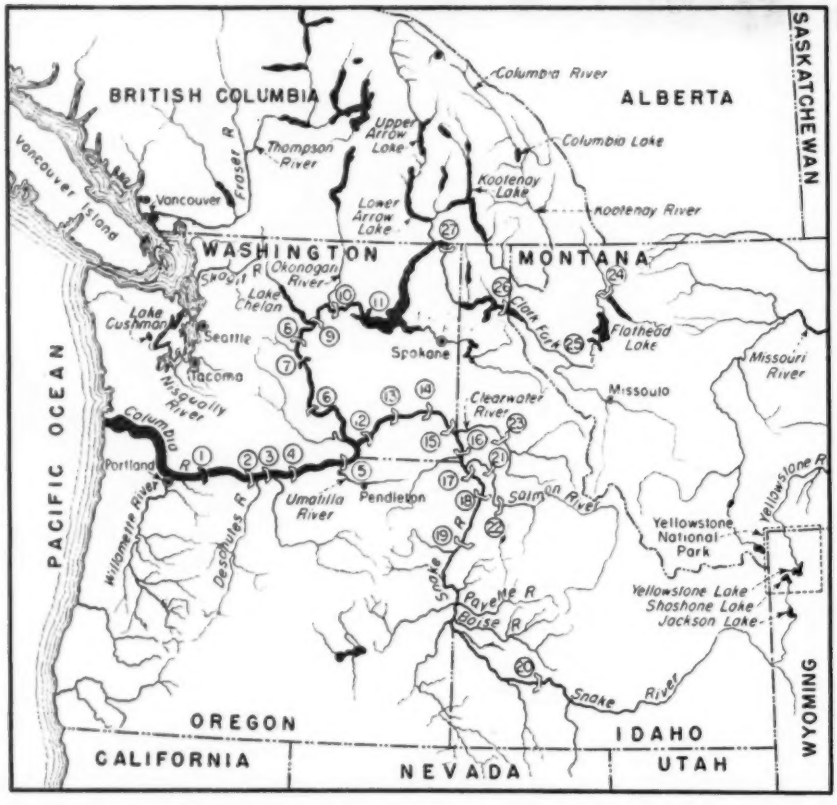
Key Structures. In the development plan of the Columbia are 140 major dams impounding water for irrigation, power generation, flood-control, navigation and pollution abatement. Thirty-five of the reservoirs that these dams will create are pools without active storage, designed for power development or for navigation and power purposes only. The remaining 98 dams will have active storage capacity of nearly 27,000,000 acre-ft.

When the basin is developed, storage in the Canadian section will add several million acre-feet to provide a high degree of flow regulation in the river system and increase firm-power generation. Coordination of the water resources of the Canadian and U. S. portions is an objective of the International Joint Commission operating through the Columbia River Engineering Board.

Of the nearly 200 power plants in the final development, the table on page 67 gives 27 of 100,000-kw (140,000 hp) capacity, and larger, along with the rivers on which they are or will be installed. These plants are keyed to the map to show their location. They are planned for a total capacity of 12,000,000 kw, and will generate 62,000,000,000 kwhr annually.

Of these great plants, eleven are on the Columbia and nine on the Snake River. The eleven on the Columbia are the largest and will utilize 95% of the total fall in the river south of the Canadian border. They range in size from 220,000 kw for Rock Island (owned and operated by the Puget Sound Power & Light Co) to 2,190,000 kw for Grand Coulee, designed and operated by Bureau of Reclamation.

Grand Coulee. This plant includes largest dam and power installation and one of the largest storage reservoirs in the world. A story describing this plant



THE 27 POWER DEVELOPMENTS of over 100,000 kw each on the Columbia and its tributaries, are either completed or projected. They have an aggregate capacity of 12,000,000 kw, and are expected to generate nearly 62,000,000,000 kwhr

will appear in the November number.

As part of the Grand Coulee project, the world's largest pumping plant is being built adjacent to the west end of the dam's upstream face. This plant is designed for twelve pumps, each driven by a 65,000-hp direct-connected 13,800-v 200-rpm synchronous motor. Six of these units with their motors are on order, the first to be installed in late 1948 or early 1949.

These pumps will lift water from Grand Coulee reservoir and discharge it over the river's bank into an equalizing reservoir now being built in the Grand Coulee. From here water will flow through canals to irrigate 1,029,000 acres of semi-arid land in the Columbia's great bend.

Bonneville. At tidewater, about 42 miles east of Portland, Ore. (144 miles above the river's mouth) is another world-record plant, Bonneville, designed and built by the U. S. Corps of Engineers. This project is a combination power and navigation development with a ship lock for 66-ft lift at low water. Ten units are installed to complete the plant. Two have 66,000-hp turbines and 43,200-kw generators, while eight units have 74,000-hp turbines (at 50-ft head) and 54,000-kw generators, giving the plant a total capacity of 724,000 hp (518,000 kw). Twice in 1946 peak loads reached 577,000 kw, or 11.4% in excess of rated generated capacity.

The kaplan turbines in this plant have the highest power of units of their type. Their runners, which are 23 ft, 4 in. dia, require 12,000 cfs of water under a 60-ft head at full load.

Power from this plant, like that from Grand Coulee, goes into the Bonneville Power Administration's high-voltage network in Washington and Oregon. Up to the end of 1946, Bonneville and Grand Coulee generated 34,000,000,000 kwhr, a large part of which went into the war effort. In the peak year of 1944, they produced 9,240,000,000 kwhr.

Dams Under Construction. Three other projects are under construction. McNary Dam, with an over-all length of 7400 ft, is being built by U. S. Corps of Engineers on the Columbia, near Umatilla, Ore., 150 miles upriver from Bonneville. This dam will include a fish ladder and a navigation lock, shown on the left in the artist's drawing on the opposite page. The dam will be a concrete-gravity design with a 1488-ft spillway, and a 20-ft turbine power house. Initial installation includes twelve kaplan turbines rated 95,400 hp at 63-ft head, and 69,000-kw generators. This gives the plant an initial capacity of 1,145,000 hp and an ultimate one of 1,900,000 hp.

Anderson Ranch, a U. S. Bureau of Reclamation project in Idaho on the Boise River, a tributary of the Snake, is well on toward completion. This is a combination power and water project with 500,000 acre-ft storage capacity and a 40,500-kw power installation.

U. S. Bureau of Reclamation has also started work on the Hungry Horse development on the south fork of the Flathead River in Montana. This project will have large water storage and power.

Authorized Developments. Authorized projects, on which work has not started, include Gage Island, Monumental, Little Goose, Granite Point and Palisades on the Snake, Detroit on the Santiam River, and Lookout Point on the middle fork of the Willamette River. These projects have an estimated power installation of 1,158,000 kw and 3,215,000 acre-ft water-storage capacity.

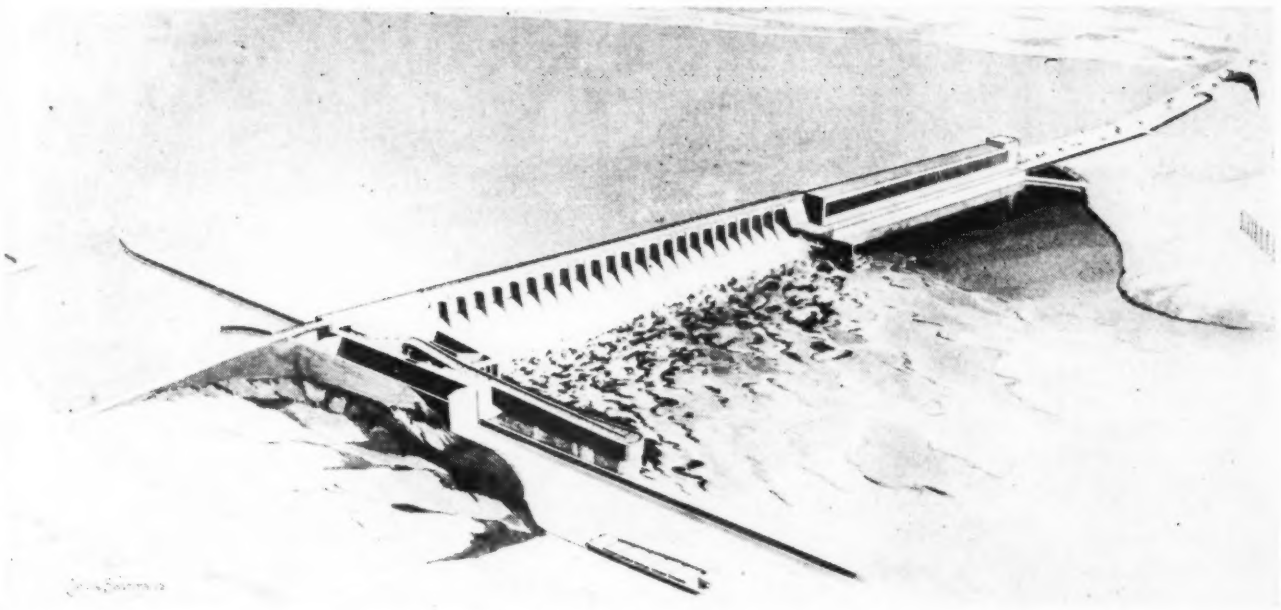
Question Raised. These developments raise several important questions. Among them are: (1) Will the projects pay their cost? (2) Where will the vast power developed find a market? (3) Why irrigate more land?

Answer to the first question is: Yes, the federal government over a period of 50 years is to be reimbursed from power and water revenues for about 86% of its investment. The other 14% will not be paid back. It is chargeable to navigation, flood control and pollution abatement.

The second question cannot be answered directly. But within the region to be reached by these proposed power developments, more than 13,800,000,000 kwhr were utilized in 1946 from public supply systems. Conservative estimates indicate that total load of the region will increase to 53,000,000,000 kwhr by 1980. On the basis of present capacity, 1980 load will require 12,000,000 kw.

Pumping water for irrigation will be an important element in future load growth. This load will increase to 1,100,000 kw and require 3,700,000,000 kwhr annually. Over 50% of this amount will be in Grand Coulee, for which six 65,000-hp pumps are now on order, as already mentioned.

Electric-steam boilers are another possibility for large power consumption. Over 100,000 kw of these boilers are now installed, and it is estimated that this load can be increased to 625,000 kw. This figure is probably conservative because in Canada and Newfoundland electric boilers of nearly 2,000,000-kw



McNARY DAM under construction on the Columbia, 150 miles above Bonneville. Artist's drawing shows 7400-ft-long dam with 1488-ft spillway, and powerhouse designed for nearly 2,000,000-hp in twenty 95,400-hp units at 87.5 rpm

capacity are installed. Several factors are coming into play to make the electric-steam boiler more attractive economically in the Pacific Northwest.

According to plans for increasing consumption, large blocks of low-cost power here will attract new industries, particularly metallurgical. Other possibilities for new markets are electrical heating, increased power consumption in homes, more complete electrification of farms and railroads. In addition, it is expected that other large industries will be attracted to the area by the rich natural resources that they can convert into manufactured products.

There are many ramifications to the third question, "Why irrigate more land?" Increase in farm acreage has fallen far short of population gain. While population increased about 50% between 1910 and 1940, farm acreage increased only 10%. This was partly compensated for by a 50% reduction in work animals on farms, and by a reduction in agricultural exports and an increase in imports.

Millions of acres of farm land are no longer fit for farming. Erosion and fertility depletion now take steady toll of crop capacity. Despite alleged improvements in farming efficiency, per-acre yield of many important crops is apparently declining. In contrast, the annual population increase is about a million. While these facts present only part of the picture, they indicate good reasons for irrigating more land to help fill the nation's food basket.

Twice within the last 30 years the U. S. has faced serious power shortages because of two world wars. This experience should have taught us that power is just as important in national defense as the most modern implements of war. This problem of national defense raises the question: "What is an adequate power reserve?" If past experience is a criterion, we need several million kilowatts of spare capacity more than we have ever had. Part of it may well be in the Columbia River basin.

PROPOSED OR CONSTRUCTED HYDRO POWER PROJECTS

Each of Over 100,000-Kw Capacity, in the Columbia River Basin in the U. S.

Map No.	River and project	State	Ultimate capacity, kw	Installed capacity, kw	Annual power gen, 1000 kwhr	Head, ft
Columbia River						
1	Bonneville	Wash. & Ore.	518,400	518,400	918,000	60
2	Dalles	Wash. & Ore.	658,000	None	4,200,000	76
3	John Day	Wash. & Ore.	480,000	None	3,200,000	59
4	Arlington	Wash. & Ore.	400,000	None	2,300,000	48
5	McNary	Wash. & Ore.	1,380,000	None	4,500,000	82
6	Priest Rapids	Wash.	720,000	None	5,200,000	131
7	Rock Island*	Wash.	220,000	60,000	1,700,000	48
8	Rocky Beach	Wash.	380,000	None	2,000,000	55
9	Chelan	Wash.	475,000	None	3,400,000	90
10	Foster Creek	Wash.	1,024,000	None	6,000,000	162
11	Grand Coulee	Wash.	2,190,000	1,460,000†	7,000,000	330
Snake River						
12	Gage Island	Wash.	231,000	None	1,250,000	105
13	Monumental	Wash.	173,000	None	900,000	75
14	Little Goose	Wash.	262,000	None	1,300,000	112
15	Granite Point	Wash.	216,000	None	1,000,000	83
16	Asotin	Wash. & Idaho	175,000	None	1,000,000	138
17	Nez Perce	Ore. & Idaho	175,000	None	1,000,000	140
18	Wolf Creek	Ore. & Idaho	425,000	None	2,600,000	436
19	Hell's Canyon	Ore. & Idaho	495,000	None	3,200,000	533
20	Bliss	Idaho	158,000	None	900,000	473
Salmon River						
21	Grevice	Idaho	209,000	None	1,800,000	
22	Whitebird	Idaho	165,000	None	1,400,000	
Clearwater River						
23	Kooskia	Idaho	259,000	None	1,700,000	456
South Fork, Flathead River						
24	Hungry Horse	Mont.	142,000	None	580,000	373
Flathead River						
25	Ken**	Mont.	112,000	112,000		
Clark Fork River						
26	Cabinet Gorge	Idaho	132,000	None	825,000	107
Pend Oreille River						
27	Z Canyon	Wash.	400,000	None	2,720,000	277
	Total		12,175,400		62,593,000	

*Owned and operated by the Puget Sound Power & Light Co. **Owned and operated by the Montana Power Co. †Of this capacity, 720,000 kw are on order or being installed.

How to Select a Control Valve

Good choice involves studying the characteristics of pumps, piping and other connected equipment that may influence the valve's ability to control system flow* In two parts: Part II

By BRUCE A IRWIN
General Sales Manager
Hammel-Dahl Company

Last month the author described different types of control valves and gave the characteristics of each. In this conclusion, he explains how to determine valve size for a given job.

▶ IF ALL FLOWING CONDITIONS are known and it is desired to determine Cv and a definite valve size, the equation may be written as:

$$Cv = \text{GPM}\sqrt{\frac{G}{\Delta p}}$$

With gas and steam similarly expressed, when Cv has been determined it is only necessary to select a valve with a Cv equal to or greater than the calculated value. Table II lists basic flow equations for determining valve capacity with Cv.

If a definite-size valve with a maximum Cv has been selected, and valve lift at intermediate positions or minimum flow rates is to be determined, only the Cv for these conditions has to be calculated. The actual percentage lift, or lift in inches, can then be determined by referring to the proper flow curve, Fig. 1. For example, a 1-in. valve has a Cv maximum of 10. If water flow is 1 gpm, and the pressure drop 9 psi, can a 1-in. valve handle this condition, and if so, what is the lift? Cv is calculated as 0.33. By referring to Fig. 1 we have 11% lift.

Easy-to-Read Chart. An accurate and quicker way of determining valve size is to use a capacity chart. Fig. 2 illustrates flow capacity from a microflo No. 5 spline plug ($Cv = 0.1$) through a ¾-in. size ($Cv = 1.0$) to a 12-in. valve with a capacity ($Cv = 1440$). The chart is easy to read. For example, assume a flow rate of 300 gpm of liquid with a specific gravity of 0.75. Pressure drop across the valve is 150 psi. From the intersection of the 150-psi pressure-drop line and the 0.75 specific-gravity line. Draw a line parallel to the flow-in-gpm scale to the intersection with the 300-gpm line. The valve-size line passing above this point is 1½-in. The required valve size is, therefore, 1½ in.

My basic philosophy of control-valve sizing is that a 1-in. valve should have a capacity of 10 gpm or a Cv of 10. Consequently, as pipe size is rational above 1 in. you can mentally calculate the Cv for any size valve by merely squaring the valve size and multiplying by 10. This calculation is true except for the 3-in. size where we have taken the preferred number of 100 rather than 90. In sizes 6 in. and larger, valve-body size controls, and the preferred-number series disappears. Fig. 3 is the flow bench on which the valve characteristic and coefficient work was done for small-sized valves, 3 in. and below.

* Abstract of a paper delivered before the first regional conference of the Instrument Society of America, Detroit, April 4, 1946.

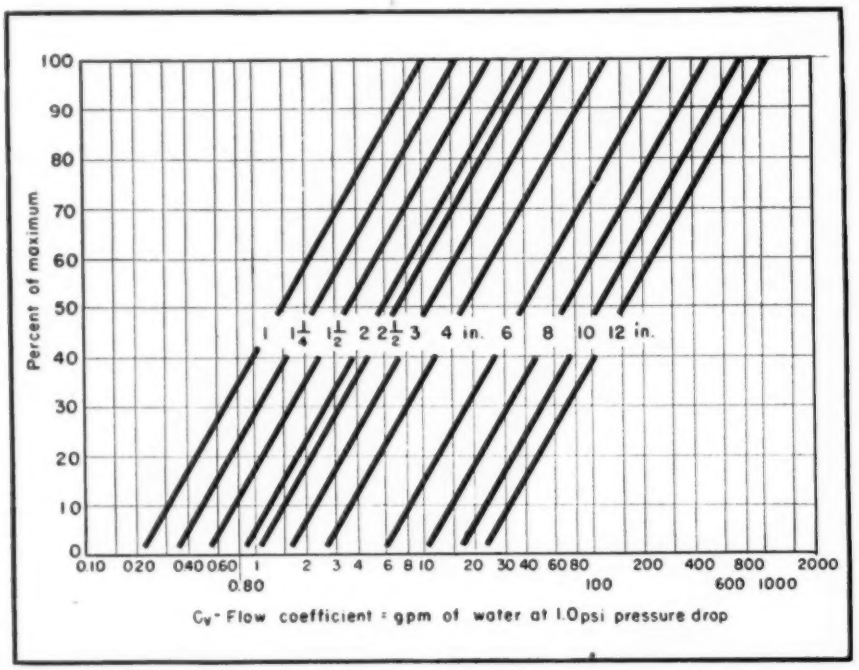


Fig. 1—Lift percentage is plotted against Cv flow coefficient for double-seated equal-percentage plugs. Capacity can be found for any stem-travel point

CONSIDER OTHER EQUIPMENT

While the equations described and the charts give a logical mathematical approach to valve selection or sizing, there is no substitute for good engineering judgment. There is a tendency to accept the field data given as being accurate and then perform a mechanical mathematical operation. There is also a tendency to concentrate our thinking on the control valve and disregard the characteristic curve of the pump, piping, heat exchangers or other equipment that may definitely influence the ability of a valve to control the system flow. Let us evaluate some of these factors.

Pressure Drop. Two classes of pressure drop are usually encountered:

1. Where the initial and terminal pressures are constant regardless of flow (makeup of low-pressure exhaust steam from a high-pressure system). This type of application concentrates pressure drop at the control valve and line friction can be disregarded.

2. Where the control valve is in series with heat exchangers, piping and other resistances. They may influence the

controllability of the system to an equal or greater extent than the control valve. Unless line size is infinite, these factors definitely affect the characteristic curve of the system. Qualitatively expressed, the pressure drop available at the valve is low at high flows and high at low flows.

If pressure drop across the control valve must be selected arbitrarily, a good rule of thumb is to assign one-third of the total drop to the control valve and two-thirds to the remainder of the system for absorption. Later we will discuss a mathematical presentation of this suggested division.

In process applications where the ratio of maximum to minimum flow is not over three, as little as 15% of the total system drop provides satisfactory control. This is definitely the low limit and a higher percentage of system drop should be used wherever possible to provide better fluid control.

If it is necessary to install a control valve with no knowledge of operating conditions, select one a size smaller than the line. If the valve works out line size, check the calculations by which pipe size was determined, as the piping system including hand valves, fittings and heat exchangers probably absorbs too much pressure drop to permit good control.

MAXIMUM FLOW

As will be demonstrated later, maximum rate of flow should not exceed twice normal rate. The stated value of the coefficients (Cv) listed previously is conservative. Therefore, 100% of valve capacity can be safely used if actual data are available. Whenever operating information can be obtained it should be employed to determine valve capacity.

On first thought flow rangeability of 50 to 1 might seem to be required infrequently. In a class (2) system, however, decrease in flow greatly increases pressure drop or energy that must be absorbed by the control valve. Let us assume that maximum flow is 100 gpm at 9-psi pressure drop, and minimum flow 5 gpm at 49-psi pressure drop. Under these conditions the port area change is calculated by multiplying ratio of maximum to minimum flow by the ratio of the square root of the corresponding pressure drops. The calculation is as follows:

$$\frac{100}{5} \times \frac{\sqrt{19}}{\sqrt{9}} = \frac{110}{3} = \frac{46+}{1}$$

The above conditions are just within the possibility of a valve with a rangeability of 50 to 1.

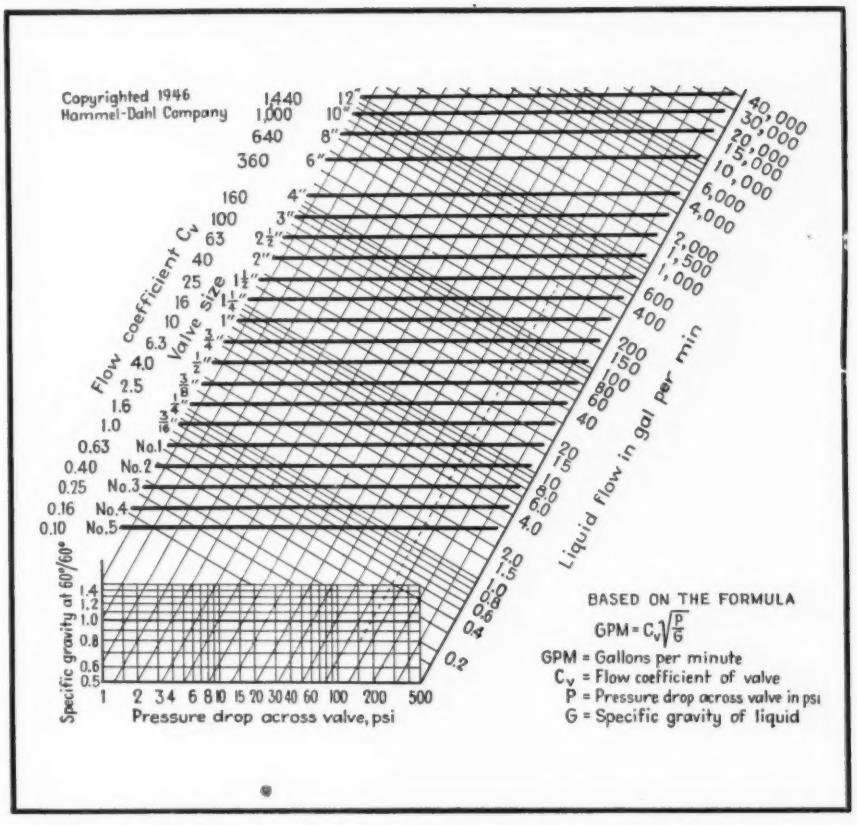

Copyrighted 1946
Hammel-Dahl Company
Flow coefficient Cv
Valve size
Liquid Flow in gal per min
Specific gravity at 60°/60°
Pressure drop across valve, psi
BASED ON THE FORMULA
GPM = Cv √(P/G)
GPM = Gallons per minute
Cv = Flow coefficient of valve
P = Pressure drop across valve in psi
G = Specific gravity of liquid

Fig. 2—An accurate, simple and rapid way to determine valve size is to use a manufacturer's capacity chart. Specific gravity correction curves are added

Effect of variation in specific gravity in valve calculations is exactly parallel to flow measurement calculations. As it is a square-root function, an error of 0.1 at a specific gravity of 1.0 for either liquid or gas causes an error of only 5% while the same error of 0.1 at a specific gravity of 0.5 causes an error of 20%.

Current research has developed some quantitative information for certain specific viscous fluids. Usual practice, however, is to calculate the valve size for very viscous fluids in the conventional manner and then make the valve one size larger.

Vaporization Interference. There are several methods in general use for valve selection involving vaporization of the fluid being handled:

1. Make a separate calculation on the vapor and liquid volume, adding the two figures and supplying a valve with a Cv or area equal to the total figure. This method assumes total vaporization in the valve body and is generally on the large side.

2. Select a valve one size larger than the Cv, calculated on a liquid basis, indicates, and make certain that size of the downstream piping is adequate. Control-valve outlet should be increased to line size as quickly as possible. This method assumes that vaporization begins in the valve body, but reaches equilibrium at some point in the line downstream from the control valve. This is the most economical procedure and is generally satisfactory.

3. Latest method is to make a heat balance.

So far, most of our discussion has concentrated on the control valve and its characteristics, and has considered the system as a whole only in a very sketchy way. Actually, our method of handling valve selection is analogous to an electrical engineer selecting a rheostat without knowing the complete circuit. Let us assume a simple system in which the valve or variable resistance is in series with a fixed resistance, which simulates friction loss in pipe, valves, fittings, exchangers, etc.

If we know the normal flow rate, fluid and pressures at P_1, P_2 and P_3, we can calculate a line coefficient that parallels the valve coefficient Cv. Line coefficient can be defined as the capacity of the system, in gpm of water at 1 psi, exclusive of the control valve.

The line coefficient C_L and valve coefficient Cv can be combined to represent flow in the system:

$$GPM = Cv\sqrt{P_2 - P_3} = CL\sqrt{P_1 - P_2}$$

$$GPM = Cv\sqrt{(P_1 - P_3)\left[\frac{CL^2}{Cv^2 + CL^2}\right]}$$

where:

GPM = gpm of fluid
Cv = valve coefficient
CL = line coefficient
P_1 = system-inlet pressure, psi abs
P_2 = valve-inlet pressure, psi abs
P_3 = system-outlet pressure, psi abs

The above equation merely states mathematically that flow through the valve is equal to that through the remainder of the system. It also assumes that the only variable in the system is the position of the plug in the valve body. If we plot the valve coefficient (Cv) in logarithmic coordinates and valve-lift percentage in linear coordinates, we can select values of Cv at various percentages of lift, including Cv maximum or 100% lift. What the formula does is to assign mathematically the correct amount of pressure drop to the valve for any selected position of valve lift, permitting accurate calculation of flow for the percentage opening selected.

In a fluid-flow system, pressure drop not absorbed by the valve is absorbed by the remainder of the system. This is a rigorous approach in comparison to the common practice of adding calculated pressure drops for the various system components.

Let us assume specifically that we have 100-psi pressure drop across our system with a normal flow rate of 100 units, which can be, for example, gpm. Also, that we can maintain the 100-psi pressure drop under any and all conditions. And that at normal flow rate, pressure drop across the control valve is 36 psi, and across the remainder of the system, 64 psi.

This ties in with my suggestion that the control valve should absorb at least one-third of the total system drop. Let us work out the valve coefficient for a *normal* valve, assuming that the flow curve is an equal-percentage curve with a 4% change in flow for each 1% change in lift, which is roughly equivalent to a valve with a rangeability of 50 to 1. Let the fluid be water to eliminate the specific-gravity factor.

Based on the above information, calculate the valve coefficient Cv and line coefficient CL.

$$Cv = \frac{100\ gpm}{\sqrt{36}} = 16.7$$

$$CL = \frac{100}{\sqrt{64}} = 12.5$$

In Fig. 1 the Cv maximum for a 1¼-in. valve is 16; therefore, this system takes a normal valve of practically 1¼-in. size. Line coefficient CL is 12.5, and it so happens that this is equivalent to 410 ft of 2-in. pipe, based on Cameron's *Hydraulic Data Book*.

In addition to finding out what a 1¼-in. valve will do in series with 410 ft of 2-in. pipe, let us install a 1-in. (0.6 normal), a 1½-in. (1.6 normal) and a 2-in. (2.5 normal) valve in the same piping system. We will then see the effect of valves smaller than line size up to a valve equal to line size in such a system. In addition to the named valves, we will include an infinitely small and infinitely large one, Table I. The only thing that changes physically is the position of the valve plug in relation to its seat, and the only variable is the resistance created by the valve plug.

With the method outlined, the actual Cv can be determined for any point in valve lift, and the actual system flow at this lift be readily calculated. As stated previously, the formula accurately proportions pressure drop to the valve and line. Therefore, total flow in the system for any point of valve lift can be easily calculated.

EFFECT OF VALVE SIZE

The tabulation, Table I, points out definitely what happens with various-sized valves wide open, or at Cv maximum, in a given piping system.

With an infinitely small valve, pressure drop is concentrated across the control valve; valve coefficient is zero, and line coefficient 12.5. As there is no flow in the system, there is no pressure drop across the line.

The 1-in. valve, which is 0.6 normal size, has a basic coefficient of 10. This size takes 61 psi of the arbitrarily selected 100-psi system pressure drop. Line coefficient of 12.5, equal to 410 ft of pipe, remains constant and absorbs 39-psi pressure drop, permitting a maximum flow rate of 78 gpm, with the valve plug in wide-open position. In other words, a 1-in. valve permits 78% system capacity.

The normal valve (1¼-in.) was, of course, the basis on which this particular assumed system was set up and no further discussion is needed about its characteristics in a piping system.

The 1.6-normal (1½-in.) valve has a coefficient of 25. As the valve size has been increased, pressure drop across the valve falls to 20 psi, line coefficient remains the same, 12.5, and pressure drop absorbed by the line increases to 80 psi. As we are arbitrarily maintaining 100-psi drop across the system, the use of a 1½-in. valve permits an increase of flow to a total of 112 gpm.

LINE-SIZE VALVE

The 2.5-normal (2-in.) valve, which is the same size as the line, has a coefficient of 40. Because of its increased size, pressure drop across the valve falls to 8.8 psi. We are, of course, still using 410 ft of pipe, with the same line coefficient of 12.5. In view of the arbitrarily proposed pressure differential of 100 psi across the system, line drop increases to 91.2 psi, the maximum flow in the system. Using a 2-in. valve in series with a 2-in. line permits a total flow of 119 gpm.

Using an infinitely large valve with an infinitely large Cv simply means that

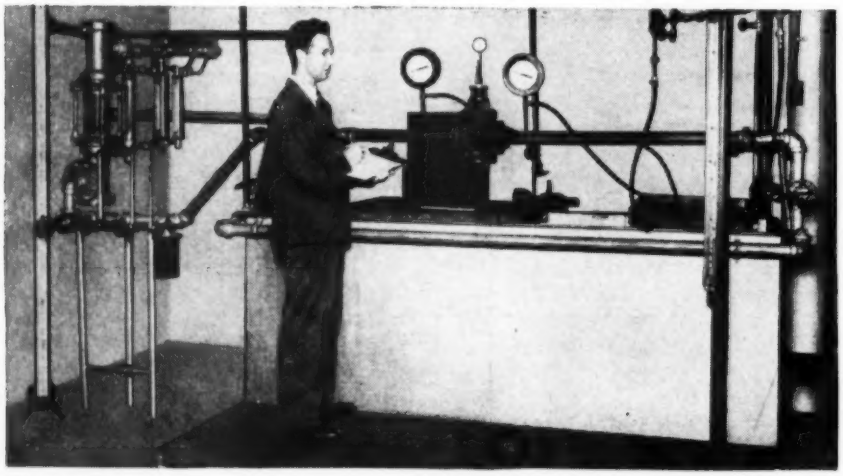


Fig. 3—Flow-bench setup, complete with metal tank on which the valve characteristic and coefficient work was done on small-size valves, 3 in. and below

TABLE I—ACTION OF VARIOUS-SIZED VALVES IN A GIVEN SYSTEM

Valve size	Cv	Valve psi drop	Cl	Line psi drop	Flow gpm
Infinitely small	0	100	12.5	0	0
(.6 N) 1-in.	10	61	12.5	39	78
(Normal) 1 1/4 in.	16	36	12.5	64	100
(1.6 N) 1 1/2 in.	25	20	12.5	80	112
(2.5 N) 2 in.	40	8.8	12.5	91.2	119
Infinitely large		0	12.5	100	125

TABLE II—BASIC FLOW FORMULAS FOR VALVES

LIQUID: $GPM = Cv\sqrt{\frac{\Delta p}{G}}$ STEAM: $W = 63\,Cv\sqrt{\frac{\Delta p}{V}}$

GAS: $Q = 1360\,Cv\sqrt{\frac{\Delta p P}{(460+F)G}}$

$W = 104\,Cv\sqrt{\frac{\Delta p P G}{(460+F)}}$

Cv = Flow coefficient of valve
d = Valve size in inches
F = Inlet-gas temperature
G = Specific gravity
GPM = Gal per min
P = Inlet pressure in psi abs
Δp = Pressure drop across valve in psi for steam or gas not greater than $\frac{P}{2}$
Q = Cu ft per hr at 60 F and 14.7 psi abs
V = Specific volume of inlet steam
W = Pounds per hour

Flow Coefficient: Cv	
d, in.	Cv
3/16	1.0
1/4	1.6
3/8	2.5
1/2	4.0
3/4	6.3
1	10
1 1/4	16
1 1/2	25
2	40
2 1/2	63
3	100
4	160
6	360
8	640
10	1000
12	1440

we have no pressure drop across the valve and are concentrating the entire 100 psi across the line. Under these conditions, the maximum flow possible in this system is 125 gpm. In other words, with a given piping system, it is not economical to attempt to increase system capacity by increasing valve size beyond the normal size. This size can be calculated mathematically, if necessary, but rationally it is generally several sizes smaller than line size. In increasing the valve size to 1.6 times normal, we increase the capacity of the system 12%.

By installing a 2.5-times-normal valve, or a line-size valve, we only increase system capacity over the 1.6-times-normal valve by an additional 7%, or a net increase of 19%. Table I also shows that there is absolutely no point in installing a valve larger than line size, as we gain only an additional 6% capacity by entirely eliminating the pressure drop across the control valve.

While this has been an arbitrarily selected system, pressure drops assigned to the valve smaller than those taken here would permit smaller increases in flow than indicated by increasing the valve size.

Safety Tips on Control of Solvents

▶ MOST PLANTS KEEP regular solvent operations safe through proper ventilating systems and other controls. Even in "safe" plants, however, employes may take it upon themselves to use solvents improperly, thus opening the way for fire or illness. Such use, or rather misuse, of solvents is not only wasteful but sometimes results in serious accidents, which give rise to unwarranted fears of properly regulated solvent-using operations.

Detailed instructions as to why a solvent must be handled in a certain way as well as what precautions to take when using it for different purposes should be issued to every employe in the plant. Only in this way can accidents be reduced.

One fairly widespread use of solvents is for cleaning hands or clothing at the end of the work day. When brought into frequent, direct contact with the skin in this way, most solvents cause drying, cracking and infection. Improper handling may also result in inhalation of unsafe quantities of solvent vapor and, in addition, may create a fire hazard.

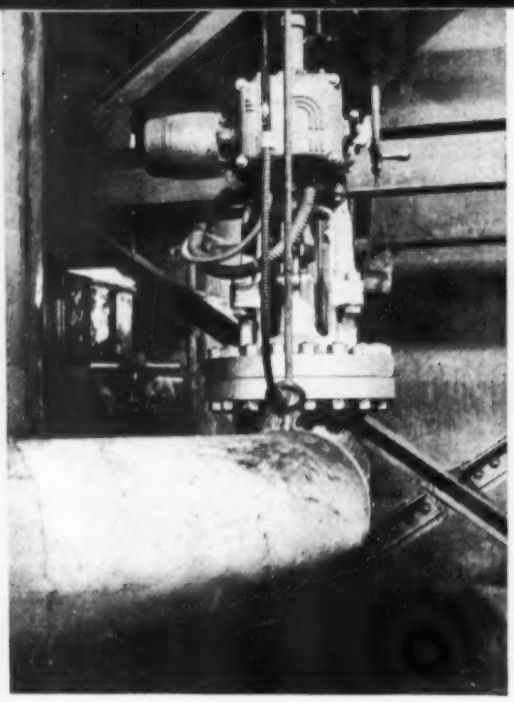
Misuse of Solvents. An unfortunate misuse of a solvent occurred in one plant when an overly conscientious workman decided to clean the greasy floor around his work bench. He borrowed a solvent that was doing an excellent job in a nearby degreasing machine. He did not realize, however, that the engineering apparatus, which controlled the solvent vapor in the degreaser, was not designed to provide protection for operations like his self-selected floor-cleaning job. He spent several days at home recuperating from solvent-vapor illness.

Taking solvents from a plant for household use has also caused many accidents. In one instance, an employe took home a large quantity which his wife used to clean a rug. Having no knowledge of the proper use of solvents, the housewife cleaned the entire carpet with the solvent without opening any windows. Inhalation of concentrated solvent vapor resulted in her death several days later.

Fire-Safety Program. Sometimes flammable solvents have been taken home to do dry cleaning. Fire-safety procedures, which are taken for granted in the plant, are often ignored in the home, with occasionally disastrous results. Elimination of unauthorized solvent use is thus important to both management and employe, and should be a permanent part of the safety program.—*Safety Research Institute.*

CORRECTION

In Part I of "How to Select a Control Valve," Sept 1947, *Power*, the last sentence of the last paragraph on p 104 should read, "Actual lift in inches of the parabolic and equal-percentage *plugs* is several times that of the *quick-opening plug*." This is a correction of, "Actual lift . . . of the *linear plug*."



STOP VALVE controls the inlet end of 650-psig 750-F steam-supply line

INSULATED 10-in. high-pressure steam-transmission line emerges from Station No. 3, of Rochester Gas & Electric Corp, which is located on the Genesee River

Mile-Long High-Pressure Steam Line Aids System Economy and Flexibility

To add steam capacity for district heating, Rochester Gas & Elec Corp uses boiler capacity in electric plant through long steam-transmission line. Besides being less costly, plan allows system sectionalization for maintenance and repairs*

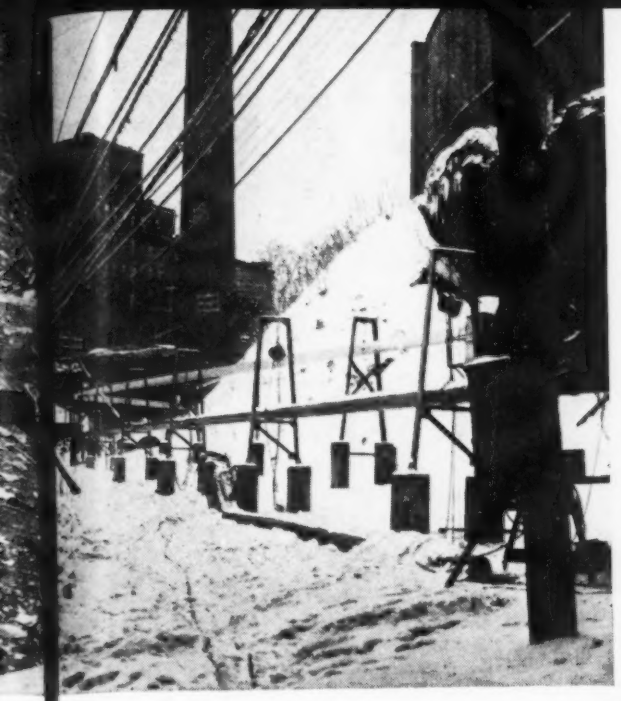
▶ LIKE MANY OTHER UTILITIES that furnish district heating, the Rochester Gas and Electric Corp, faces the problem of adding steam-generating capacity to supply the commercial or downtown area of the city. A steam plant with three Bigelow-Hornsby boilers, of 120,000-lb-per-hr capacity each, supplies this area. During the past few years all three of these boilers were operated during peak loads, leaving no reserve capacity.

Three plans, which the utility company considered for providing additional capacity, were to: (1) add a new boiler at the present plant (2) build a new plant at another location on the system (3) construct a high-pressure steam-transmission main from a steam-electric plant in the factory district about one mile away and tie it in with the commercial district. After carefully studying these possibilities it was decided to adopt the third plan.

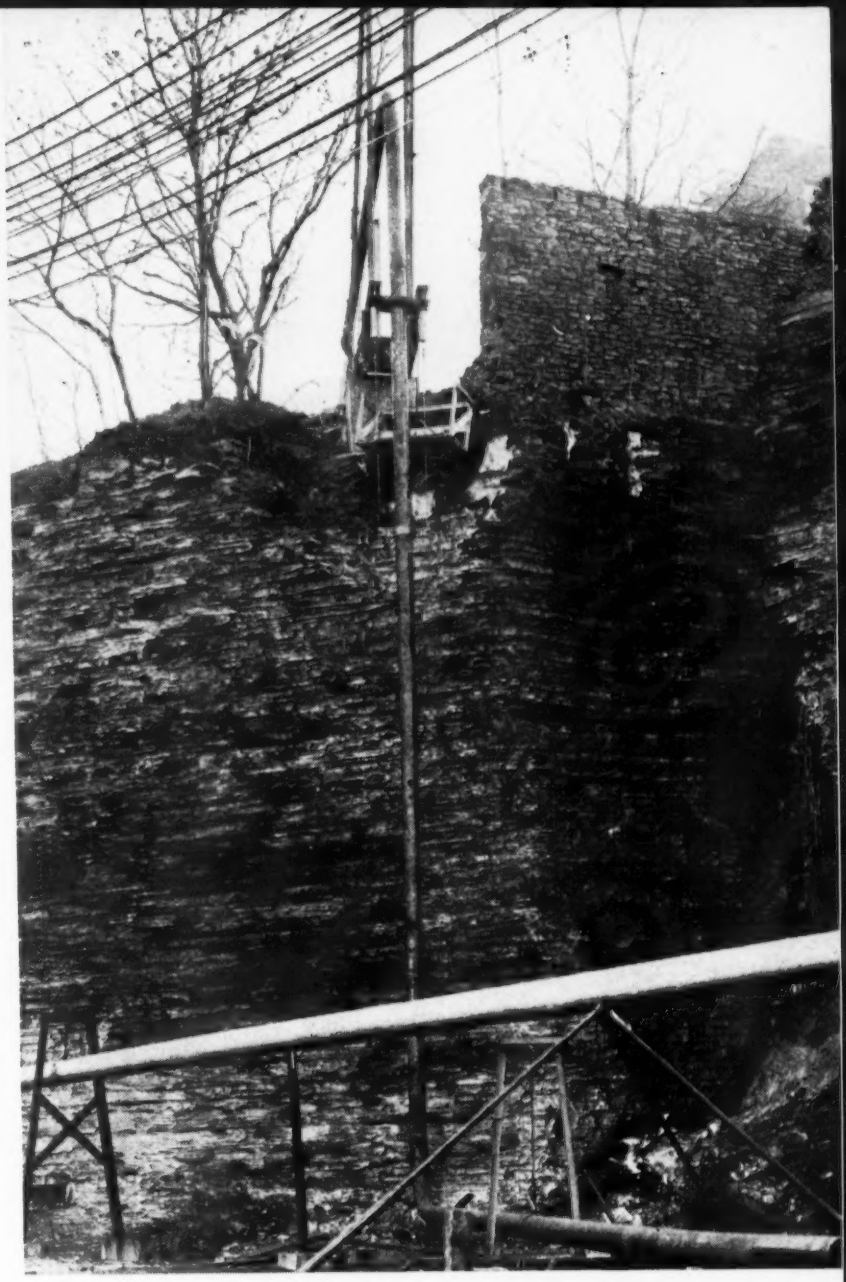
* From talk before National District Heating Association at Atlantic City, N J, June 26, 1947.

PLACEMENT of 21-ft prefabricated insulated pipe sections in street trench before hooking up. All pipe joints were electrically welded through line

BEFORE BACKFILLING underground pipe sections were concrete covered



FOR 812 FT, the line passes through part of river gorge suspended from steel supports



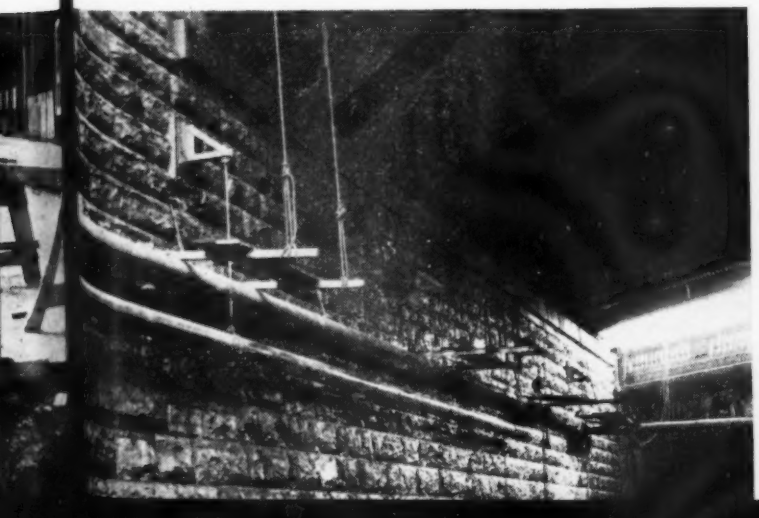
CONSTRUCTION of 65-ft rise of steam-transmission line from river gorge to street level. The pipe is anchored at base of vertical rise

By JULIUS J SCHENCK
Rochester Gas and Electric Corp

Transmission Main. With an initial pressure of 650 psig, and 250 psig at the point of delivery, a 10-in. main was selected to pass 200,000 lb per hr of steam. The addition of desuperheating water increases the available steam about 10% to a total of 220,000 lb per hr. This amount of steam equals the installation of a new boiler at the downtown plant, but is much less expensive.

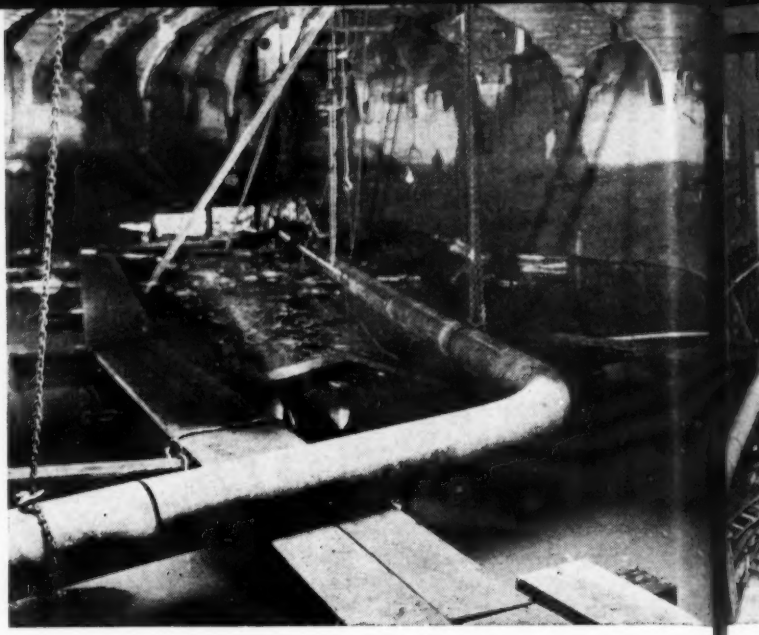
Another distinct advantage is the flexibility of this installation. It permits shutting down the downtown plant for

UNDER THE RAILROAD BRIDGE the line (under construction) is supported from brackets in the bridge abutment

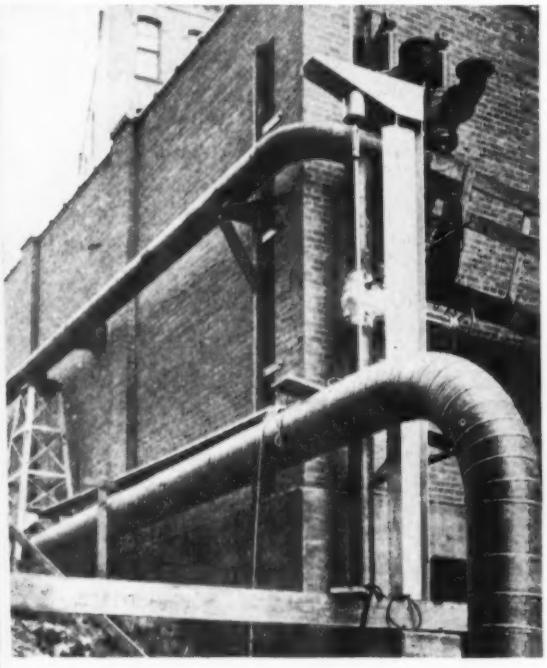


STEAM MAIN crosses Genesee River by being suspended from side of bridge, continues alongside of buildings

BEFORE LIFTING pipe sections into position along river side of building they were floated down on rafts



SECTION OF MAIN passing under street bridge in position and welded before being hoisted to final place

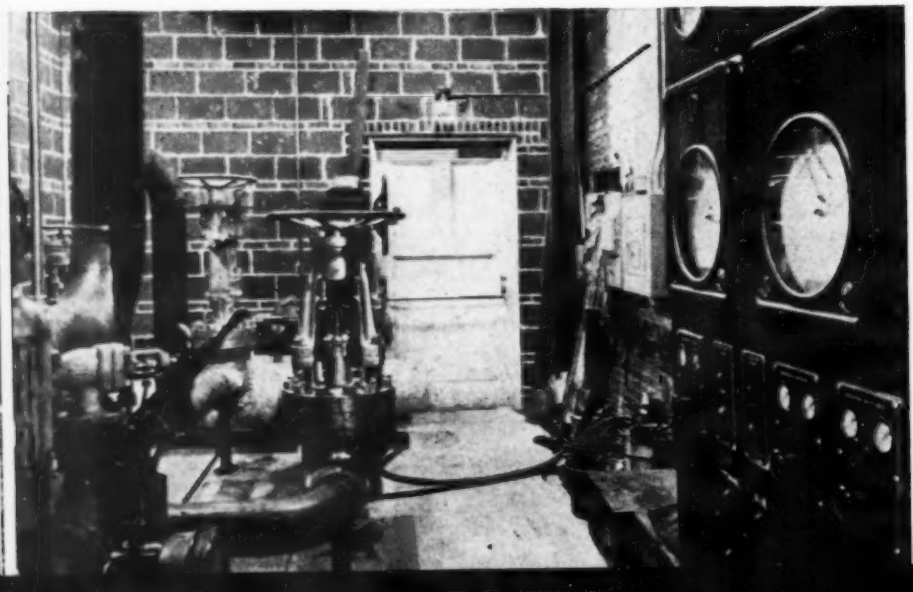


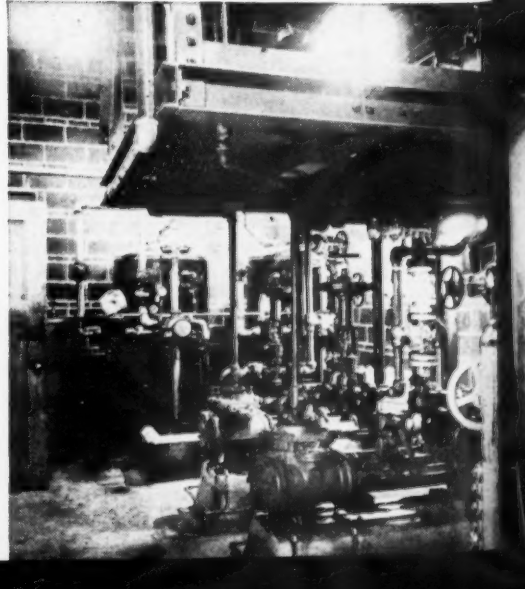
MAIN EMERGING (above) from building at left runs along outer wall of substation through expansion loop before entering desuperheater house

STEAM LINE (left) entering desuperheater house, lower, with line above leading to safety pressure-relief valve located at upper right

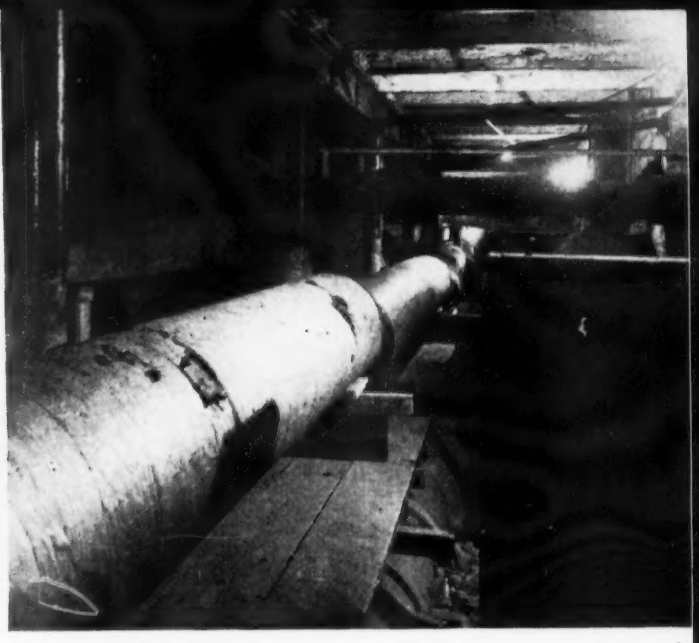
INTERIOR of desuperheater house with desuperheater and control valves at left, control board at right. Substation operators, next door, supervise house

DESUPERHEATING HOUSE'S interior shows desuperheating water pumps





THIS EXPANSION LOOP takes care of 5 to 6 foot changes in 1000-ft straight run of pipe located in raceway



PREFABRICATED PIPE units in old mill raceway before being placed in position on concrete piers at right

the summer months; during this time repairs can be made to the boilers. It also allows sectionalizing the system in the event of leaks. The repairs that can be made on the system at this time greatly reduce the number of customer interruptions with both sources producing.

The steam, taken from the station main at 650 psig, 750 F, flows to the downtown system, which is designed for 400-psig maximum pressure and 500 F. This requires a pressure-reducing and desuperheating station, which is located at the end of the transmission main just before it feeds into the distribution system.

About 40% of the steam-main route passes on company property, the remaining 60% occupying public and private right-of-ways. Test holes were made in the streets to locate underground obstructions before laying out the design. Actual line construction started Nov 1, 1945, and was completed Nov 1, 1946, in time to get the line operating satisfactorily before the heavy-load period.

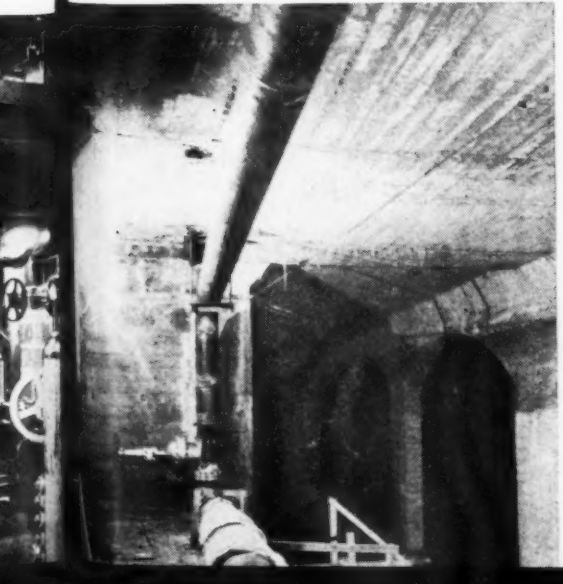
Operation Satisfactory. Operating experience has been very satisfactory. The steam flow has been up to 75% of capacity, and all reducing and desuperheating equipment has functioned properly. In the beginning some difficulty had been experienced with water carryover, but by making changes in the steam-line size at the desuperheater this fault was corrected.

The equipment, used in construction of the steam line and its pressure-reducing and desuperheating station, is listed in the next column.

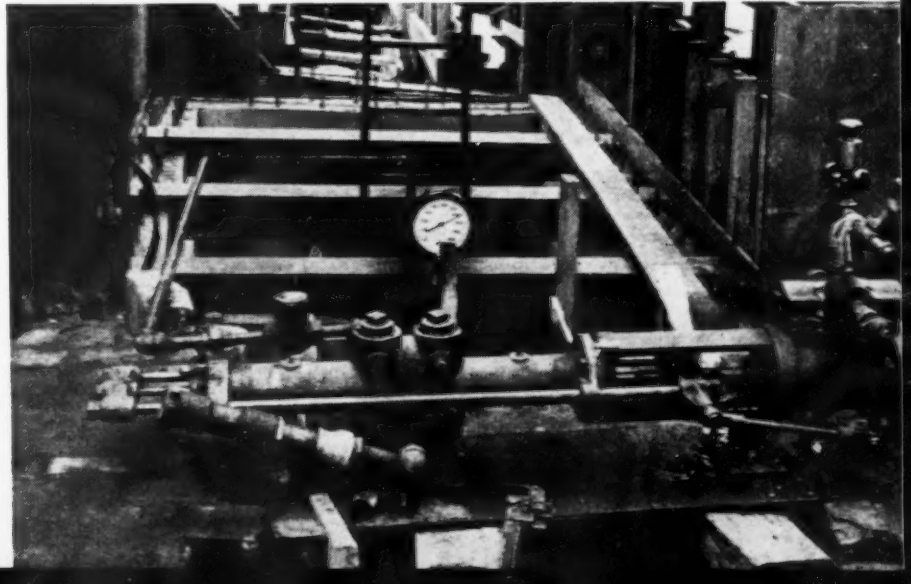
Equipment Table

Design and construction — Blaw-Knox Co, cooperating with company engineers.
Pipe hangers, steel A frames, supports, pipe bends—Blaw-Knox Co.
Excavating, concreting—C P Ward, Inc.
Pipe—10-in. schedule 80—grade B steel—spec A106.
Insulation—one thickness Unibestos, inner 1½ in. 1200-F limit, outer 2 in. 750-F limit.
Conduit—Ric-wil insulated pipe units.
Traps—Armstrong bucket.
Valves—Lunkenheimer.
Desuperheater—Blaw-Knox Co.
Water Softener—Permutit Co.
Feed Pumps—McGowan Reciprocating.
Controls—Bailey Meter Co.

TRANSMISSION LINE'S tie-in point to 250-psig district heating system



PROVING APPARATUS set for hydraulic testing of high-pressure steam-transmission main at 1400 psig. Line rated 200,000 lb per hr capacity 650 psig



Diesel Lube-Oil Specs—Trap for the Unwary?

They may be if true purpose of specifications is not clearly understood, says Dr. E B Nugent, Sun Oil Co, who points out hazards of blind adherence to test values that do not indicate how lubricants perform under actual engine conditions

▶ IF I WERE TO CALL ON the average diesel-engine owner or operator, I would want to tell him certain things before ever asking, "May I sell you your diesel lubricating oil?" Time wouldn't permit tracing the entire evolution of the diesel, but I would discuss the various types and tell how weight per hp had been cut from around 250 lb to as low as 9 or 10 in some cases. I would explain what this weight reduction has meant in engine construction, and how higher speeds mean higher heats and loads, and hence greater oxidation of lube oil.

Fuels would also enter the story, as they affect dilution, carbon deposits and wear, and how some additives and cetane improvers in fuels affect lube oils. It would then be a simple matter to tell how oil companies and users have determined three distinct types of lubricating oils, generally known as *regular*, *premium*, and *heavy duty*.

Lube-Oil Types. As might be expected regular oils find use in those engines operating under favorable conditions, without excessive heats. Premium oils are those with oxidation inhibitors to overcome effects of higher temperatures, oxidation conditions, catalytic effects of various metals, etc. I would describe heavy-duty oils as being designed for specific engine models and tell how the U. S. armed forces used them in World War II with good results, explaining what can and cannot be done with these oils.

Then I would be in a position to point out the dangers of blind adherence to cut-and-dried specifications in selecting lubricants, making plain that such specifications cannot, in any practical way, give a full evaluation of oil performance in service.

At about this point, my engineer listener would ask why specifications and tests have been developed and widely used, if they don't do their job. My answer would lie in showing that they *do* their job, but it is a different job from that often expected of them. Specifications are needed to control the manufacture of lubricating oils—not to act as a yardstick in selection. In making any product, an exact description or specification is necessary so the item can be reproduced exactly. In clothing, for example, size, shape, style, color and material might be specified. In cooking, not only is it necessary to know the ingredients and their proportions; we must also know the order in which to mix them and under what conditions. The latter step is what we know as *process control*.

Process Control. So it is with oil refining. Certain tests and process controls have been set up to guide the conversion of basic lubricating-oil stocks into engine oils. As service demands become more severe, new production-control problems arise and additional tests are needed. The net result is many tests to maintain uniform quality. Specifications are essentially a means of establishing quality standards.

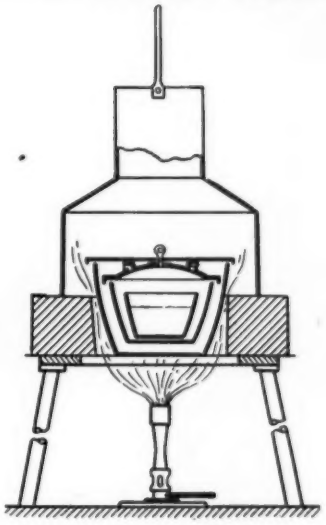
Specifications alone do not tell the story but some purchasers believe that if they buy on specification and the product exactly meets it, the oil should be correct. Since design is not a static art, engines constantly put new burdens on lubricants and oil that was once satisfactory may become quite unsatisfactory. Because of limitations in conventional testing methods, attempts to define oil characteristics by the usual specifications do not necessarily insure obtaining the correct lubricant.

Too often, the situation resolves itself into a controversy between maker and user on the value of conventional specifications as a measure or guarantee of oil quality and suitability for a given service. To come to our own conclusions, let's review oil-testing methods, considering their meaning and limitations. At the turn of the century, commonly used lube-oil tests included determination of: gravity, flash and fire points, viscosity, color, and pour point. Since then many new tests have come along but old ones retain prominence.

These tests may be likened to the diagnostic questions your doctor asks when he tries to find the cause of that pain in your shoulder. From the results of tests and questions, a *skilled physician* may locate the trouble. Similarly, from results of physical and chemical tests, a *skilled oil technologist* is able to estimate the suitability of a given oil for a given job or predict the qualities needed for the job. Results from study of specification tests are no better than the skill and experience of the man making the study. Full evaluation must include service-type testing.

Standard Tests. The ASTM has a standard procedure for adoption of a new test or method. This involves cooperative testing by those skilled in the art, using standard samples. If con-

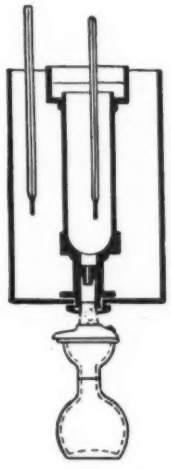
TYPICAL TESTING



CONRADSON CARBON

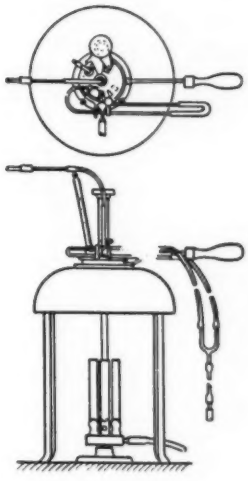
Indicates relative carbon-forming propensity. Oil is evaporated from porcelain crucible, containing two glass beads, inside covered iron crucible resting on sand in sheet-iron crucible. A circular hood and chimney rest on a refractory ring. After oil distills and vapor burns, residue is weighed and expressed in percent of sample

METHODS FOR CONTROL OF LUBRICATING-OIL QUALITIES



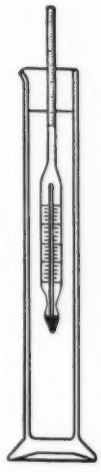
VISCOSITY

Saybolt Universal viscosimeter consists of tube with standard orifice, immersed in a bath to keep temperature constant. With oil at test temperature, time to reach receiving-flask level is measured and viscosity expressed in seconds. For heavy oil, *Saybolt Furol* unit is used and time is in seconds *Furol* instead of in seconds *Universal*



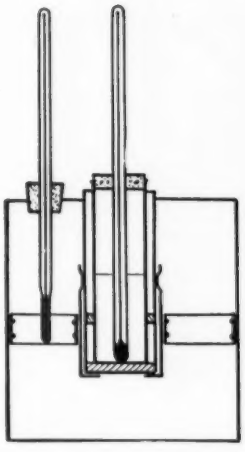
FLASH POINT

Pensky-Martens closed tester consists of brass cup with a special cover carrying a thermometer, stirrer and flame-exposure device. Stove heats oil and as temperature rises, test flame is applied at regular intervals. *Flash point* is temperature of first flash



GRAVITY

Specific gravity is ratio of oil density to density of distilled water. *API gravity* is an arbitrary scale related to specific gravity by formula (text). Specific gravity is determined by hydrometer and the observed value is corrected from test temperature to standard 60 F



POUR POINT

Test jar fits into glass jacket, resting on disk of cork or felt. Cooling bath around jacket holds desired temperature. As oil cools it is examined. Cloud point is temperature at which haze first shows; pour point is lowest temperature at which oil is still able to flow

sistent results are obtained, the procedure is published as a tentative method. It is still subject to revision and may be dropped in a number of years for many reasons. If after a reasonable period it still proves satisfactory, it becomes a standard test method. Each year the society publishes a reviewed volume of all standard test methods.

Published test procedures often include *reproducible standards*. These are the limits of agreement to be expected when a given sample is tested repeatedly by the same operator in the same laboratory, and by different operators in different laboratories. Remember that these methods tell how to run the test and how reproducible the results should be, but they do not say what they mean in terms of selecting the proper lubricant for a given service. The interpretation of the results lies with the oil expert. Standard tests of primary interest to diesel users can be described as follows.

Gravity. Determination of gravity (ASTM designation D287-39) measures weight of oil in comparison to that of an equal volume of water. There are two methods of stating gravity. One, *specific gravity*, is just as expressed above, the distilled water used for comparison being at the same temperature as the oil, usually 60 F. Specific gravity of water is one.

The method applied only to petroleum products is known as *API gravity*. This is expressed in degrees of an arbitrary scale in which water has a value of 10.0 deg and lighter liquids have higher numbers. There is a definite relation between API gravity and specific gravity:

$$\text{Degrees } API = \frac{141.5}{\text{Sp gr at } 60\text{F}} - 131.5$$

Practically all petroleum products weigh less than water so API gravity is normally more than 10 and specific gravity less than one, but the method of gravity measurement should always be specified.

Gravity tests find wide use in refinery operations control because products from a given crude source have definite boiling-point ranges and viscosities that are related to gravity. Since this test is easily and quickly made it forms a convenient control.

From the user's point of view, gravity is important in filling operations since weight, volume and temperature are tied together. If any two are known, the third can always be computed. Gravity is also useful in combination with other tests for identifying oil types. For example, paraffin-base oils run 8-10 deg API higher in gravity than naphthenic oils of equal viscosity.

Unfortunately, gravity has fallen into use as a specification item intended to exclude all but certain types of oils. It follows, therefore, that using gravity in specifications for obtaining oils to meet specific service conditions can act to exclude products equal to or better than those included. The ASTM reports that gravity is of little or no significance as a measure of quality or usefulness, and its use in specifications should be avoided.

In connection with gravity, remember always that it varies with temperature. This results from the fact that oil expands or contracts as temperature rises or falls. Expansion rate is practically the same for all oils.

Pour Point. Pour-point specifications

aim at obtaining oils that handle easily at lowest expected temperatures. Pour point is also important when oils must be transferred from storage to oil pump. In using results of the ASTM pour-point test (D97-39), even under closest supervision individual determinations on identical oil samples in the same lab and with the same operator may vary as much as 5 F, and in different labs by up to 10 F.

The ASTM states that pour point is an indication of the temperature below which it may not be possible to pour or remove oil from its container, or below which it might be dangerous to use oil in gravity lubrication systems where flow depends on head. Pour point is determined, however, with no agitation. In engines, oil pumps circulate oil at temperatures below the pour point because of the agitation the oil receives and because there is usually a considerable head of oil above the pump intake, which is assisted by the pump's suction.

It is often unreasonably stated that pour point measures resistance to starting in cold weather. Oil does not become solid except at temperatures well below ASTM pour point so that agitation resulting from turning the engine over restores reasonable fluidity.

Flash and Fire Points. ASTM test D92-46 measures temperatures at which enough of the oil sample is volatilized to give a momentary flame for flash-point and to support combustion for firepoint. It might be said that these tests are a hangover from the days when kerosene was the most valuable light distillate, and gasoline was a waste product. Since inclusion of gasoline in the kerosene cut gave a product that might form an explosive vapor at ordinary temperatures, minimum flash and fire points were set to guarantee that no gasoline was present. The so-called closed-cup testers of today are used for checking inflammability of kerosene, fuel oils and petroleum solvents. As other products were developed it became customary and logical to extend to them these same tests only as a means of production control and classification.

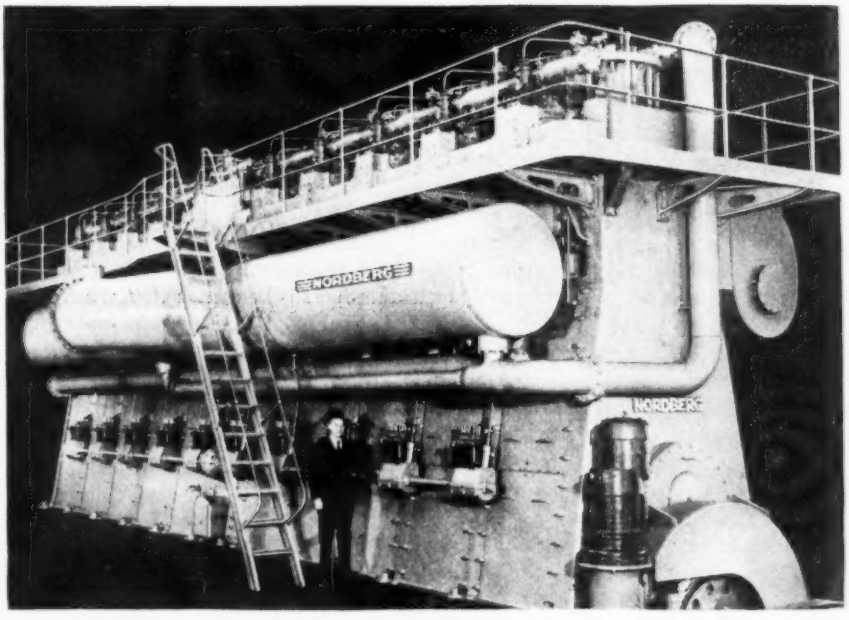
It is evident that flash and fire tests serve as a criterion of nothing except the volatile vapors which come from any oil. Addition of a slight amount of any light volatile fluid to the heaviest of lube oils depresses the flashpoint markedly. Consequently, engine oils, even if in service only a few moments, show a drop in flashpoint because of dilution. Flash is, therefore, not necessarily an index of an oil's volatility.

Flash tests often go into specifications to assure supply of a certain type of oil in the belief that it gives superior results. Additives in today's oils, plus research and new refining methods, make the general type of oil of much less importance than the method of refining. Quoting from ASTM, we find that . . . "flashpoint of a lubricating oil bears no direct relation to its usefulness . . . the use of flashpoint limits in lubricating oil specifications is actually

(*Continued on page* 158)

Chile Gets Largest Diesel Yet Built in U. S.

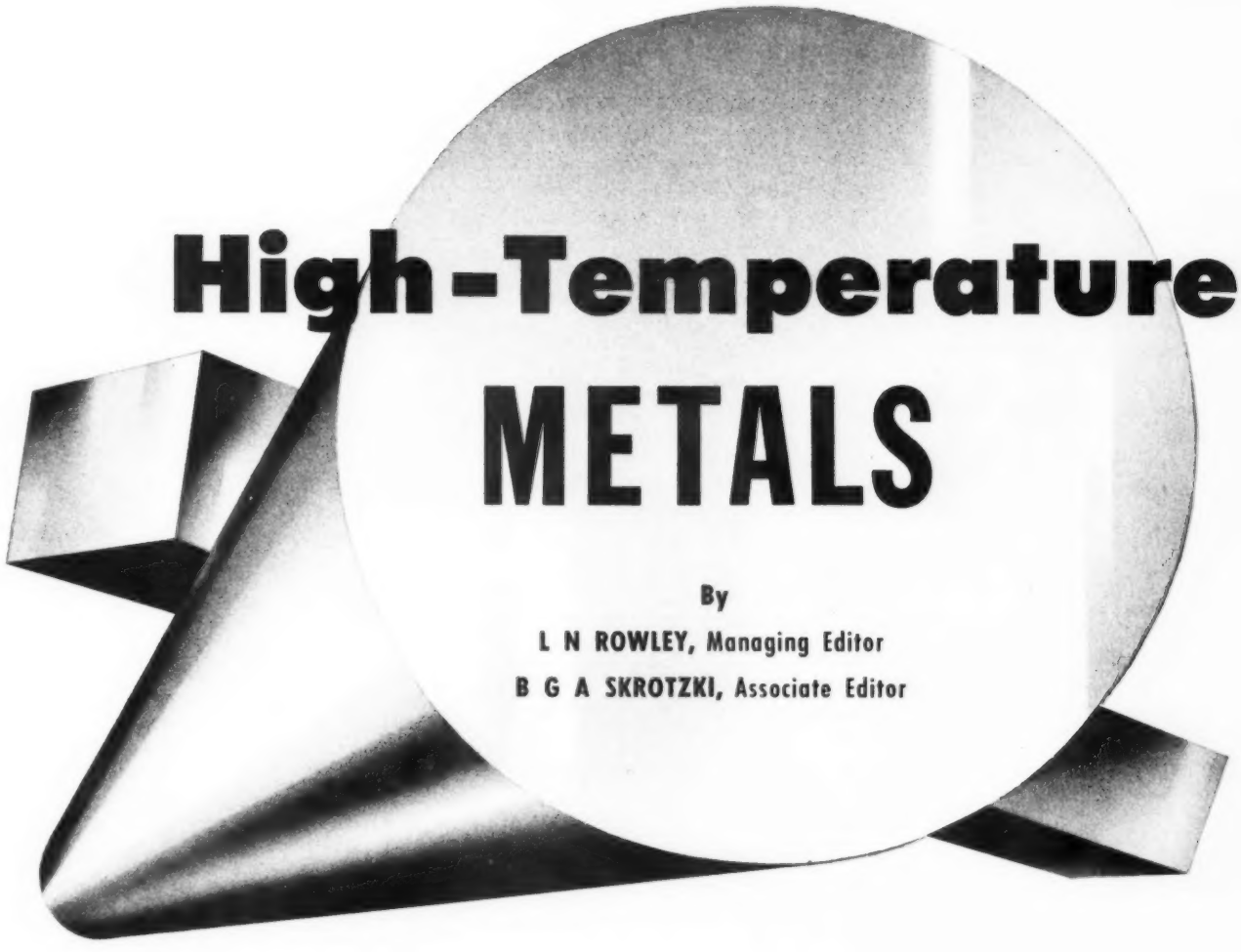
▶THE MOST POWERFUL single-acting diesel generating unit yet built in this country is being installed in the Pedro de Valdiva power plant of Lautaro Nitrate Corp Ltd, Chile. With ten 29x40-in. cylinders and a normal rating of 7100 hp at 164 rpm, this Nordberg engine drives a 5000-kw 6600-v 3-phase 60-cycle General Electric generator to supply power for mining and processing nitrates. A duplicate is under construction for Marshalltown, Iowa, plant of Iowa Electric Light and Power Co.



Design follows that of other Nordberg 2-cycle engines. Bedplate, cast in two sections and bolted, supports "A" frames carrying separate cylinder blocks doweled and bolted. Tierods, tightened by special hydraulic jacks, take all tension stresses. Two 5-crank forgings form crankshaft. Two-piece pistons consist of cast-steel oil-cooled heads and skirts resting on crosshead flanges. Crosshead guides bolt to "A" frames. A 7-feed lubricator driven from a layshaft supplies each cylinder; general lubrication is full-pressure.

Engine differs from other Nordberg 2-cycle units in location of camshaft, which is overhead, and fuel pumps, which mount directly over the camshaft. Fuel-injection lines are thus short and direct. Engine controls are placed for convenient operation from the floor. A motor-driven blower furnishes scavenging air; automatic plate valves prevent backflow of gas and consequent contamination of incoming scavenging air.

Tests on engines of this type indicate a low fuel rate of 0.38 lb per bhphr, including power to drive scavenging blower. Fuels up to 1500 ssu at 100 F have been burned successfully.



High-Temperature METALS

By

L N ROWLEY, Managing Editor

B G A SKROTZKI, Associate Editor

Civilization began, it might well be said, when man learned to work metals. In them he found the qualities of strength and hardness needed for tools, weapons and early crude machines. Over the centuries he learned to make simple combinations of metals—alloys—possessing characteristics not found in the original elements. He also devised many ways of fabricating these versatile materials.

These arts became increasingly important as inventive genius brought forth more complex machines and structures. But they remained *arts* until relatively recent times, and only in the past hundred years or so has the study of metals and their properties grown to the stature of a science.

At first, the new science emphasized improvements in production and fabrication, particularly in the direction of more uniformly controlled and better products. As a firm basis of fundamental knowledge was built it became possible to attack many detailed problems and to develop alloys for specialized purposes – the vast variety of alloy steels, the lightweight metals and corrosion-resistant alloys, for example. In the past quarter century advances in technology, particularly in the power and chemical-process fields, turned attention to development of alloys capable of withstanding high temperatures under stress.

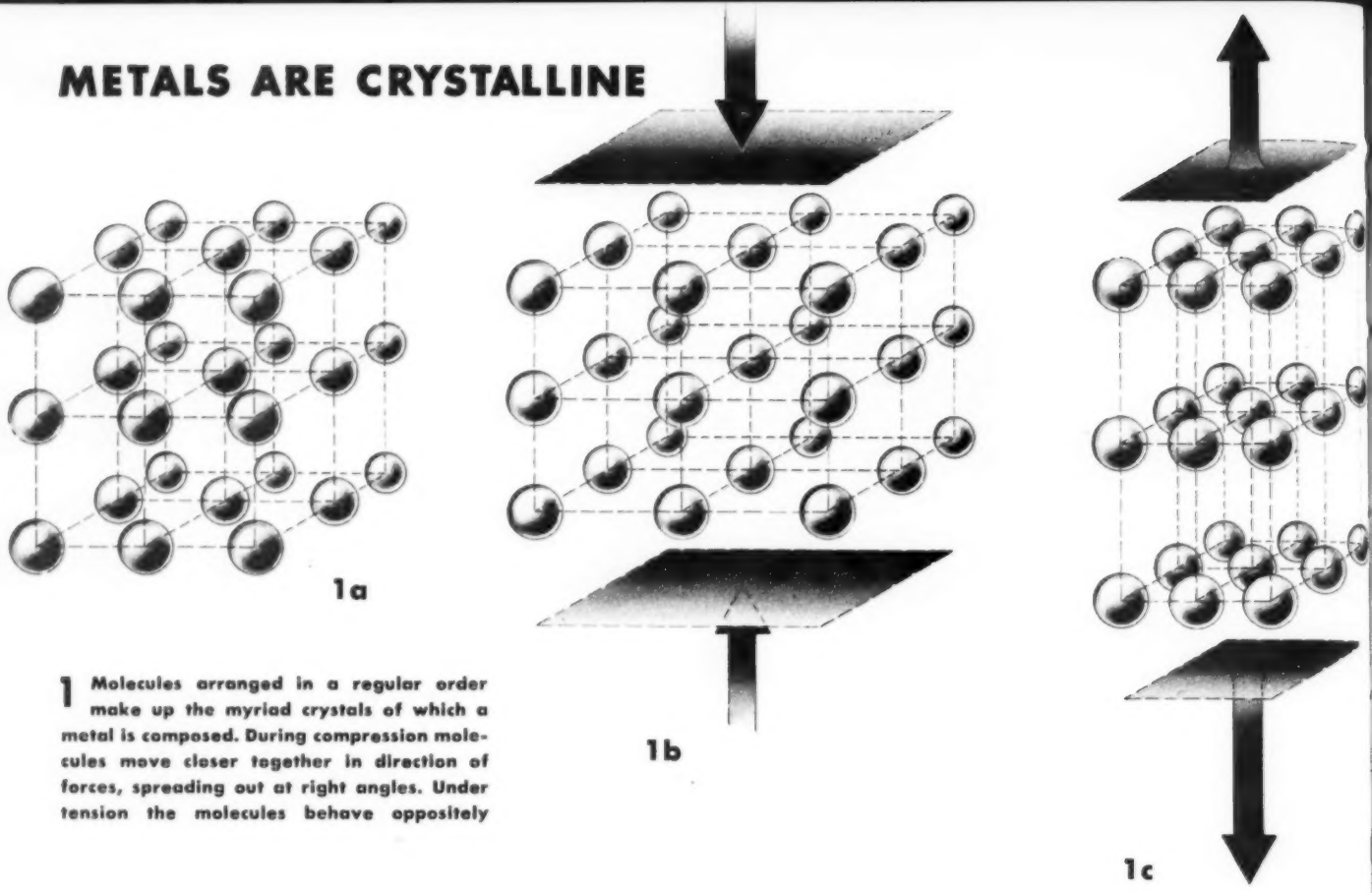
Today, with designers of gas turbines, jet engines and rockets clamoring for ever better materials, high temperature stands in the forefront of the problems facing the metallurgist. The complexity of the task cannot be over-estimated. It is evidenced by the years of painstaking work needed to push steam-plant operating temperatures from about 750 to 1000 F and to reach 1300-1500 F in short-life gas-turbine and jet-propulsion units. At the same time, realization of performance advances possible with still higher temperatures provides a powerful incentive for an all-out attack on the problem in laboratories all over the world.

While today's research aims at the temperature frontiers in jet and rocket work, its results will have far-reaching influence in the stationary power field. Metals for higher temperatures will lift efficiency levels in steam plants and help bring the gas turbine to full commercial realization. No power engineer with an eye to the future can afford to ignore such potentialities.

For this reason, POWER devotes this 64th special section to a survey of recent developments in high-temperature metals. For the engineer grown "rusty" on the basic concepts of metals and their behavior under stress, the section begins with a condensed review. This serves as a foundation for the following discussion of the new alloys, their properties and the special problems involved in their application.

The practicing power engineer does not need to be a metallurgist, but he does need to know how metals research will affect his future. It is our hope that this special section furnishes the desired broad picture.

METALS ARE CRYSTALLINE



1 Molecules arranged in a regular order make up the myriad crystals of which a metal is composed. During compression molecules move closer together in direction of forces, spreading out at right angles. Under tension the molecules behave oppositely

How Materials Behave

To understand the requirements high temperatures impose, and the characteristics of alloys developed for this service, we need to know the answers to some fundamental questions. What are metals and alloys? How do they behave under different conditions? What properties do designers and fabricators look for in determining the suitability of a metal for a specific purpose? How are these properties measured?

METALS AND ALLOYS

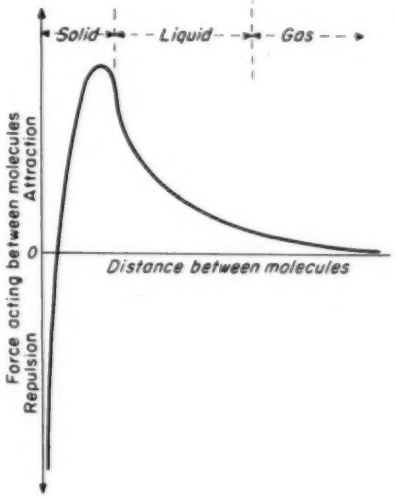
Many of the 96 elements are metals, some of prime importance in commercial applications. Because iron, as well as its compounds, occurs abundantly in nature and has desirable strength and fabricating properties, it has been widely exploited for centuries. Copper, lead, tin and zinc likewise have relatively long histories. Nickel and aluminum, now commonly used, are modern materials in that they have been commercially available only in recent times. Other metals that find considerable commercial use are listed as "utility" metals in the table on the facing page, as distinguished from less frequently employed metals classed as "special."

Alloys. Metals are often used in their pure elementary form, but their range of usefulness is greatly extended by combination with each other or with non-metallic elements to produce *alloys*. By such combinations, properties can be altered to meet special needs, and entirely new characteristics developed. Some alloys, such as brass and bronze, have seen use since early times, but most of the vast number of alloys have been produced in recent years to meet ever more severe demands of modern technology. Alloys are usually divided into: (1) *ferrous*, containing iron, and (2) *nonferrous*, without iron.

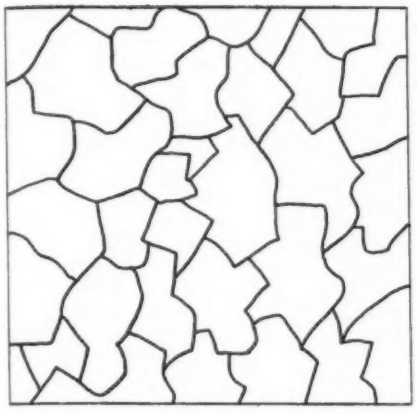
METAL CHARACTERISTICS

In the solid state, metals and their alloys are composed of *crystals*. In each crystal, the molecules arrange themselves in regular order throughout, a distinguishing characteristic. At a given temperature, the molecules assume definite distances from each other, the forces they exert being in balance. If the crystal is compressed on two opposite surfaces, Fig. 1, the molecules move closer together. Powerful forces between the molecules resist this movement, hence much energy is needed to push the molecules from their balanced positions.

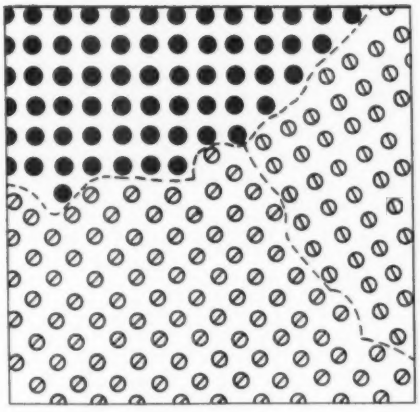
If the crystal is stretched by being pulled from opposite sides the molecules move apart. Again powerful forces, this time of attraction between



2 Molecules hang together because powerful forces of attraction or repulsion come into play when they are displaced from the position where they balance



3 Under a microscope metal is seen to be composed of millions of grains; these are all crystalline in structure. Molecular forces hold grains together



4 Axes along which molecules arrange themselves in adjacent grains aren't parallel to each other, but assume all possible positions in volumetric space

the molecules, resist the action away from balanced conditions. Fig. 2 shows the general relation of forces acting on the molecules and the distance between them. This relationship differs for each metal and alloy.

Crystal formations in metals take on various shapes and sizes depending on the nature of the metal and its processing. The crystals, more commonly known as *grains,* can be seen clearly under a microscope at magnifications of 100 and greater, Fig. 3. Molecules are, of course, much too small to be seen with a microscope, any individual grain consisting of millions of molecules. The axes or lines along which they arrange themselves in one grain do not parallel those of adjacent grains and may display any angle of inclination with each other in space, as in the simplified sketch of Fig. 4.

Alloy Structure. Alloys, consisting of two or more elements, are formed by mixture in the molten state. The elements are usually soluble in each other when melted. Sometimes they remain so when they harden to the solid state, but in most cases they separate partly or wholly when solidifying, forming distinct crystals of each element and their combined forms.

Metals in solid solution form entirely new molecules and have properties, such as specific gravity and thermal expansion, completely different from those of the constituent elements. Solid solutions differ from chemical compounds in that the proportion of the elements is not fixed but may vary over a wide range. In alloys where the elements do not form solid solutions they separate out into individual crystals forming a mechanical mixture.

Alloys are made to improve some characteristic of the principal metallic element. They are usually harder than their elementary constituents and wear better but are apt to be less malleable. With a few exceptions, those that include solid solutions have a specific gravity greater than the mathematical average of the specific gravities of individual elements.

METAL PROPERTIES

To make it easier for designer and fabricator to compare the suitability of the many different metals and alloys for various applications, it is customary to describe their behavior by certain clearly defined *properties.* These are listed in the table at the right. *Physical constants* express the weight relative to the volume occupied. How a metal transfers heat and how it reacts to temperature are listed under *thermal properties,* which are also physical constants. *Chemical properties* concern the makeup of the material as to the elements and their proportions, and its resistance to corrosion and oxidation attack. *Electrical, optical and magnetic properties* do not concern us here.

Mechanical Properties. While no property of a metal can be disregarded, *mechanical properties* are of principal interest to the engineer. These are the basic factors determining size and shape of the structural or machine part of the metal to be fabricated. First of the mechanical properties, *strength,* has six different phases depending on how the deforming forces are applied: (1) tension (2) compression (3) shear (4) torsion (5) fatigue (6) creep. The following paragraphs and Fig. 5 explain these actions.

Tensile forces tend to pull the material apart against the *attractive* intermolecular forces, Fig. 1c and 5a, lengthening the metal in the direction of the applied forces and eventually rupturing it if the forces are large.

Compressive forces tend to push the material into a smaller volume against the *repulsion* intermolecular forces, Fig. 1b and 5a, shortening the metal and crushing it if the forces are large.

Shearing forces tend to make adjacent planes in the metal move parallel to each other, in opposite directions. Fig. 5f shows a horizontal plate clamped in a die and subjected to double shearing by the punch above, which may "cut" the plate on the two edges of the die shown by dotted lines.

Torsional forces work on rotating shafts. At any point along the shaft length, there is resistance to the forces producing rotation, so there is a ten-

METALS CLASSIFIED ACCORDING TO USE

Utility Metals

Aluminum	Al	Lead	Pb
Antimony	Sb	Magnesium	Mg
Arsenic	As	Manganese	Mn
Bismuth	Bi	Molybdenum	Mo
Cadmium	Cd	Nickel	Ni
Chromium	Cr	Silver	Ag
Cobalt	Co	Tin	Sn
Copper	Cu	Tungsten	W
Iron	Fe	Zinc	Zn

Special Metals

Barium	Ba	Tantalum	Ta
Beryllium	Be	Titanium	Ti
Calcium	Ca	Uranium	U
Columbium	Cb	Vanadium	V
Platinum	Pt	Zirconium	Zr

PROPERTIES OF METALS

Physical Constants:
1. Density
2. Specific gravity

Mechanical Properties:
1. Strength
2. Toughness
3. Ductility and malleability
4. Hardness

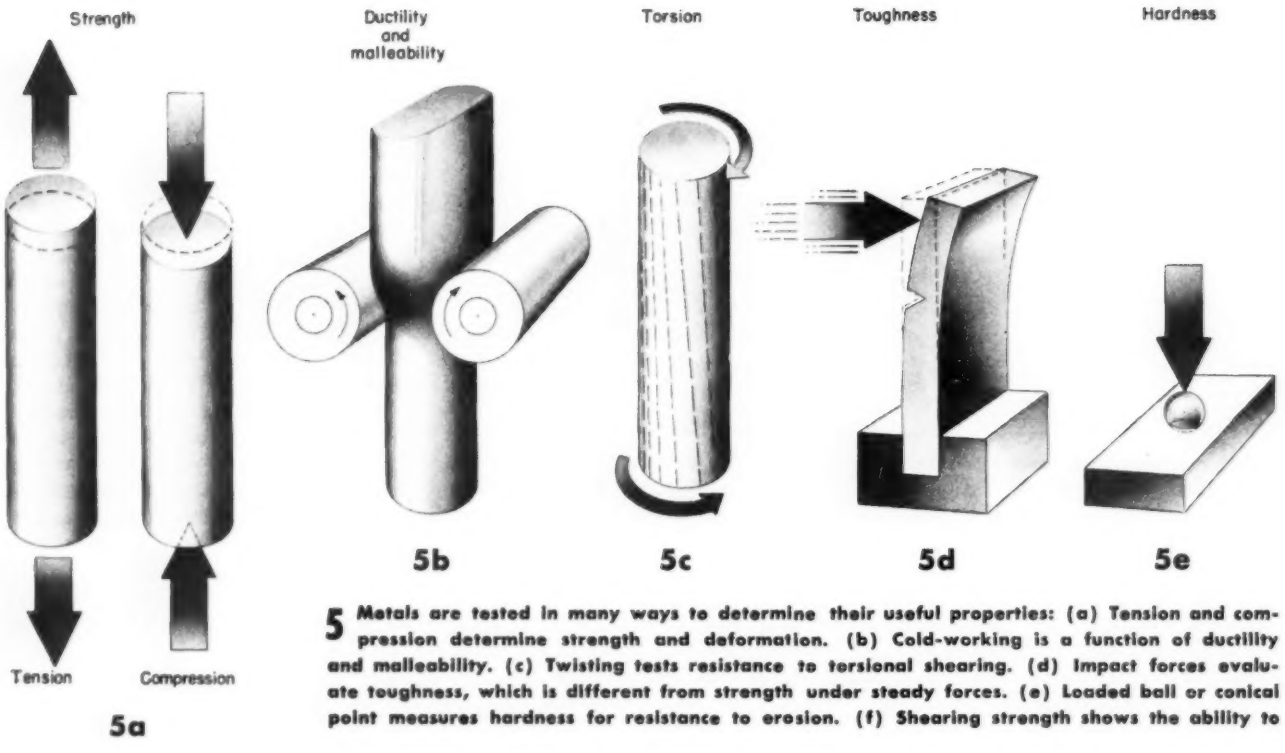
Chemical Properties:
1. Composition
2. Corrosion resistance
3. Oxidation resistance

Thermal Properties:
1. Heat conductivities
2. Expansion
3. Specific heat
4. Latent heat of fusion
5. Melting point

Electrical Properties:
1. Specific resistance

Optical Properties:
1. Reflectivity

Magnetic Properties:
1. Permeability
2. Saturation
3. Hysteresis loss
4. Transformation temperature



5 **Metals are tested in many ways to determine their useful properties: (a) Tension and compression determine strength and deformation. (b) Cold-working is a function of ductility and malleability. (c) Twisting tests resistance to torsional shearing. (d) Impact forces evaluate toughness, which is different from strength under steady forces. (e) Loaded ball or conical point measures hardness for resistance to erosion. (f) Shearing strength shows the ability to**

dency to shear on a plane perpendicular to the axis, Fig. 5c. In contrast to the shearing forces mentioned, which cause parallel and opposite motion of adjacent planes, torsional forces cause these planes to *rotate* in relation to each other.

Fatigue depends on the nature of the load that produces any of the four deforming forces just discussed. In ordinary tension, compression, shear and torsion, the forces involved are relatively steady in magnitude. But in many practical applications, *repetitive* forces are met. In these cases, force may fluctuate between tension and compression, Fig. 5*g*, or between two values of either tension or compression. Because of minute flaws that exist in all materials, repetitive forces cause cracks to form that spread through the metal progressively, overloading the remaining sound material and producing ultimate failure. Such rupturing, called *fatigue failure*, results from the repetition of force application rather than the amount of force alone. Although tension and compression are used as examples here, repetitive shearing and torsional forces also cause fatigue failure.

Creep occurs when force is applied continuously to metals at high temperature. At ordinary temperatures application of a force less than that producing rupture causes a metal to deform a certain amount. This deformation remains constant as long as the force is applied. At high temperature, however, application of a constant force produces *continuous* slow deformation, or creep, until failure results. Some very soft metals like lead creep even at room temperatures, but for most high-strength metals creep is not significant at temperatures below about 750 F.

Other Mechanical Properties. The various strength properties of metals discussed under tension, compression, shear and torsion are evaluated by tests in which forces are applied smoothly and gradually from zero to a maximum. In practice it is found that forces, if applied suddenly, cause failure even though they are not large enough to rupture metal if applied gradually. Resistance of materials to these *impact* forces is called *toughness*, Fig. 5*d*, and this factor often proves the limiting one in designing a machine part.

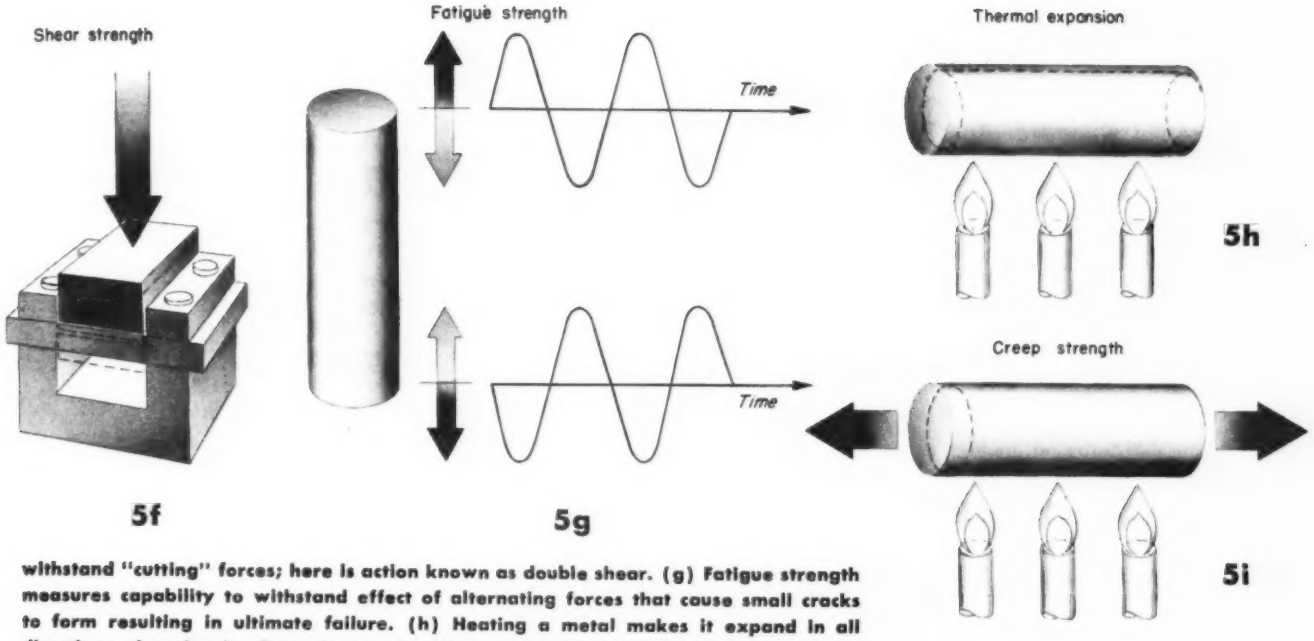
Ductility and *malleability* are those properties that permit forming or cold working metals by bending, deep drawing, spinning and cold heading, without rupture or application of excessive force, Fig. 5*b*.

Resistance to erosion is evaluated by the property of a metal known as *hardness*. This property is essentially relative and it is difficult to predict actual performance from test results. Hardness may be evaluated in many ways, but most depend on measuring the penetration of either a ball or cone into a test specimen under a force of a given amount, Fig. 5e. The harder the metal, the less the penetration.

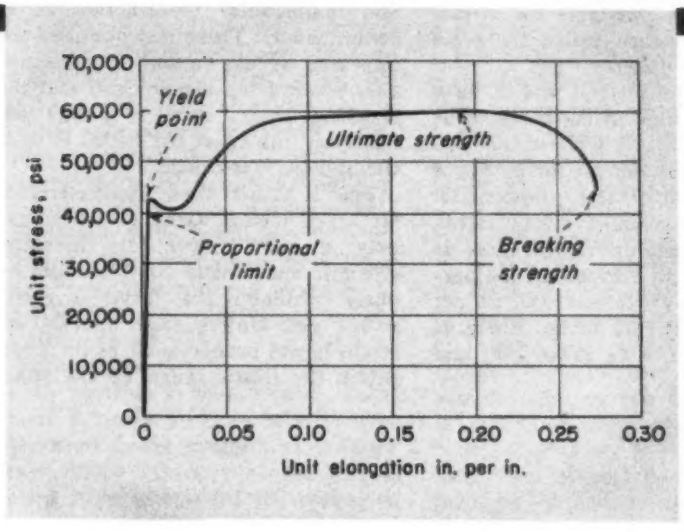
TENSILE TESTING

When a metal sample is tested for tensile strength its behavior depends on its chemical composition and the way its processing has affected the crystalline structure. Its behavior may be like that of a ductile steel as in Fig. 6 and 7. For simplicity, assume the sample has a cross-sectional area of 1 sq in. This means that the *force* applied is numerically equal to the *stress*, which is the force per unit of area in lb per sq in., or psi. As the tensile force increases until the stress reaches 40,000 psi, the test cylinder stretches or *elongates* uniformly in direct proportion to the force applied. Elongation in fractions of an inch per inch of length is known as *strain*. Elongation is exaggerated in *B* and *C* of Fig. 7.

As stress increases above 40,000 psi, the specimen stretches rapidly until 60,000 psi is reached. During this load increase, *rate* of elongation behaves erratically, Fig. 6, increasing rapidly during the last 5000-psi increment of stress. At 60,000 psi the test piece begins to show a reduction in area at some one particular cross section in its length. This is the beginning of



withstand "cutting" forces; here is action known as double shear. (g) Fatigue strength measures capability to withstand effect of alternating forces that cause small cracks to form resulting in ultimate failure. (h) Heating a metal makes it expand in all directions, changing its dimensions and setting up stresses if expansion is restrained. (i) Under continuously applied stress, heated metal elongates or "creeps" slowly

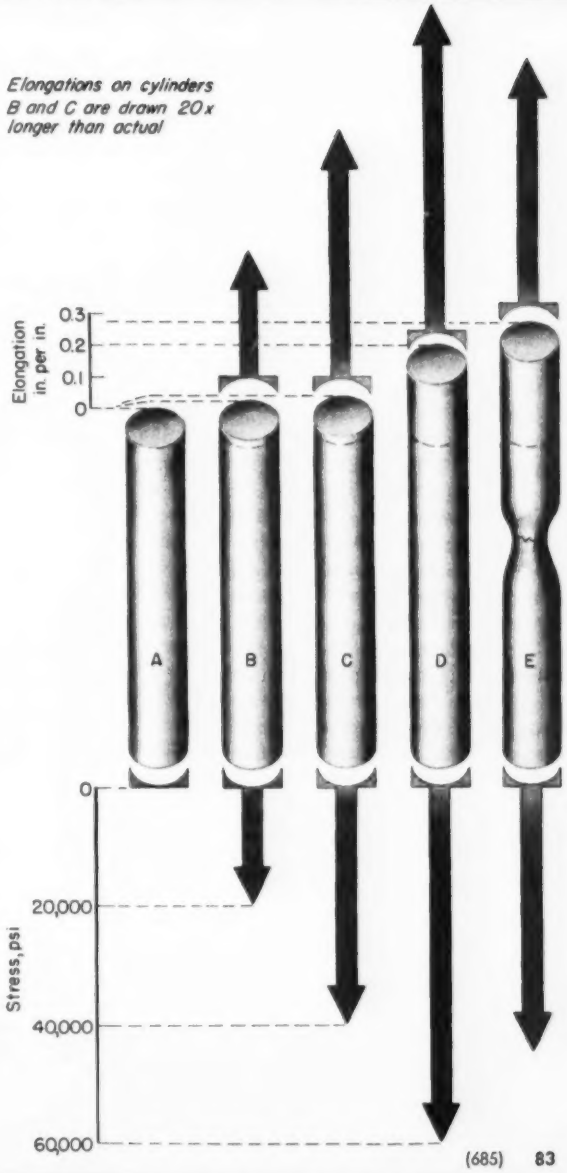


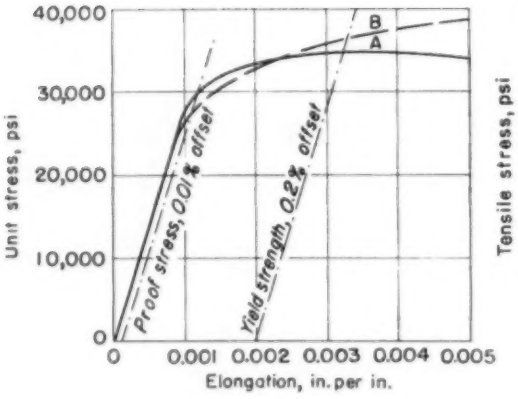
necking. Elongation then proceeds with continued application of stress of a *decreasing* magnitude and a continuing reduction in necked area until the specimen ruptures at the point of smallest cross section.

Modulus of Elasticity. If the stress in the specimen of Fig. 6 and 7 were removed after reaching 40,000 psi, the test piece would return to its original length. In other words, this metal is *elastic* up to 40,000 psi and deforms in proportion to the applied stress as shown by the straight line of the *stress-strain curve* of Fig. 6. The point where strain ceases to be proportional to stress, 40,000 psi here, is the *elastic* or *proportional limit*. Most metals find their practical use at stresses below this limit.

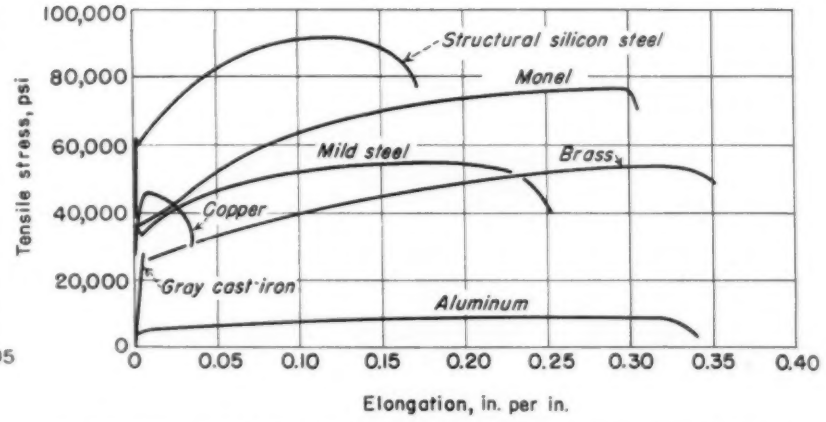
6 above Plot of tensile-test results shown pictorially in Fig. 7. Elongation, also known as strain, is slight over elastic range, proceeds rapidly after elastic limit

7 *right* Under tensile test, metal expands only slightly over elastic range, elongates plastically at rapid rate, finally "necks" at some point in its length, ends by rupturing





8 **Owing to difficulty of finding exact elastic limit, yield strength at 0.2% offset, proof stress at 0.01% offset are used instead**



9 **Ductility and malleability are measured by the relative amount of elongation between yield strength and breaking strength. Brittle materials like cast iron have no ductility. They break while still within their elastic range**

When stressed beyond the proportional limit, metals reach their *yield point*. If stress is removed after the yield point is passed, the metal does not regain its original dimensions but takes a definite *set* or permanent elongation in the direction of applied stress. The dip in the stress-strain curve following the yield point is characteristic of many steels and irons. Other metals show a smooth rise with increasing elongation.

Highest point on the curve marks the stage where the material begins to neck and represents the highest applied stress, called the *ultimate strength* of the metal. Right-end termination of the curve is commonly called the *breaking strength*, the point at which the metal ruptures.

Examining the straight part of the curve, Fig. 6, we note that deformation is extremely small within the elastic limit. The less the deformation for a given stress, the *stiffer* the material. This stiffness is shown by the slope of the curve, which is the ratio of stress to strain. This ratio, called *modulus of elasticity*, has psi as its numerical units. The higher the modulus, the stiffer the material. Each metal and alloy has its own modulus.

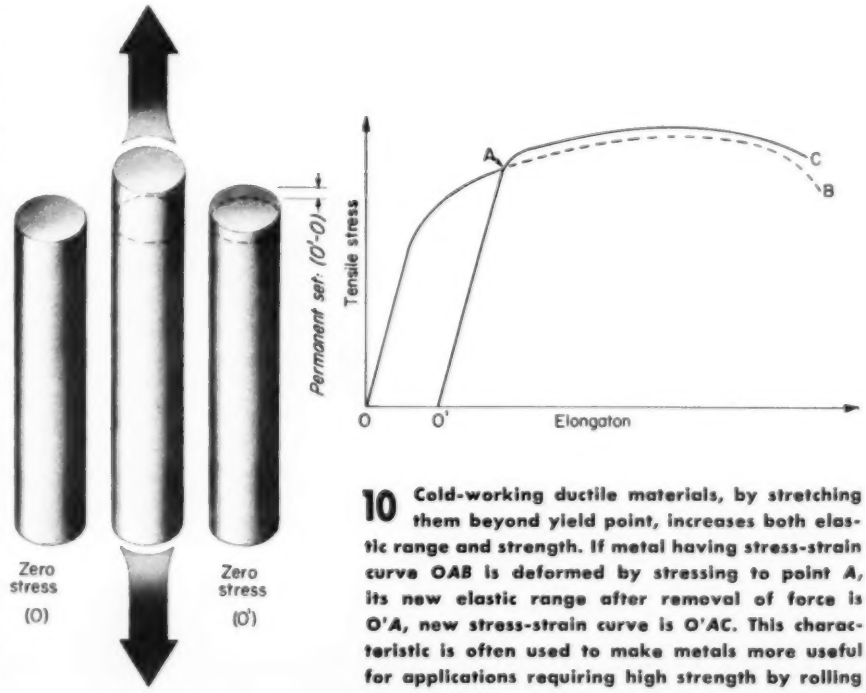
These stress-strain curves are determined for compression, shear and torsion as well as for tension, which has been discussed at length as an example. In each case the stress-strain curves exhibit characteristic points like those on the tension curve shown —proportional limit, yield point, ultimate strength and breaking strength.

Proportional Limit. Because of the gradual curvature of the stress-strain curve near the proportional limit it proves difficult to locate precisely this point and the yield point. The latter is virtually impossible to determine if the metal does not exhibit a droop as in *B* of Fig. 8. For this reason, yield strength is often determined by drawing a straight line on the stress-strain plot parallel to the straight portion or elastic range of the curve, and displaced from it 0.002 in. per in. along the elongation axis. Where this line intersects the stress-strain curve is then called the *yield strength, 0.2% offset*.

In Fig. 8, materials *A* and *B* have the same modulus of elasticity while the yield strength, 0.2% offset, is 35,000 psi for *A* and 36,700 psi for *B*. For a closer estimate of the proportional limit, the *proof stress, 0.01% offset*, is used. It is determined the same as the yield strength except that the parallel line is drawn from 0.0001 in. per in. elongation at zero stress. In Fig. 8, proof stress for *A* is 30,000 psi, and for *B* 27,500.

Cold-Working. Metals are shaped into many useful forms at room temperature. Such operations are known as *cold-working*. How much shaping can be done depends on the metal's ductility (*elongation* as in tension) and malleability (*contraction* as in compression). These two qualities are indicated by the amount of deformation between the elastic limit and the breaking point; if these points are relatively far apart the metal is ductile, if close it is brittle.

Fig. 9 shows these characteristics for seven metals. Gray cast iron has only a short curve; its breaking strength and elastic limit simultaneously terminate the curve at about 28,000 psi. Unlike most metals, its strain is not proportional to its stress within the elastic range. Of the seven



10 **Cold-working ductile materials, by stretching them beyond yield point, increases both elastic range and strength. If metal having stress-strain curve OAB is deformed by stressing to point *A*, its new elastic range after removal of force is O'*A*, new stress-strain curve is O'AC. This characteristic is often used to make metals more useful for applications requiring high strength by rolling**

metals shown, brass has the highest ductility, while aluminum, monel, mild steel, silicon steel and copper follow in decreasing order. Ductility is entirely independent of strength, but the latter proves a measure of the force that is required for cold-working.

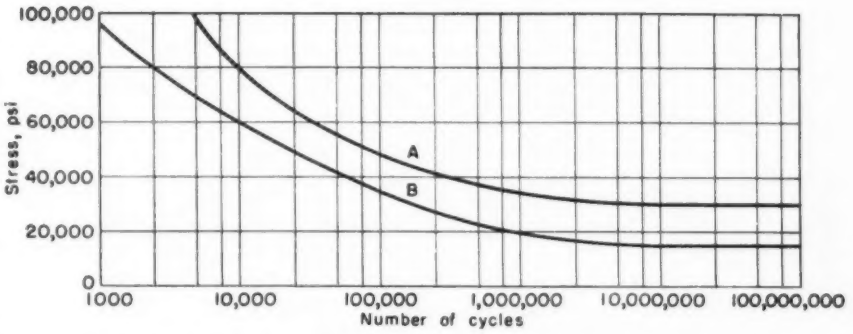
Cold-working a metal usually increases its strength and hardness. For instance, in Fig. 10, *OAB* represents the stress-strain curve for a ductile metal. When stretched to point *A* it has a new elastic range between *A* and *O'* after stress is reduced to zero. It then has a permanent set of *O'—O*. After this cold-working it would show a stress-strain curve like *O'AC*, both ultimate and breaking strengths being higher.

Endurance Limit. As mentioned, useful strength of a material depends to a large extent on the way load is applied. Thus a metal may have a high ultimate strength under load applied steadily but if load varies frequently, useful strength diminishes markedly. Special testing machines determine this fatigue characteristic. Several specimens of the metal are made up to identical specifications. They are placed in the testing machine one at a time, each subject to load of a different magnitude but with all loads fluctuating in the same manner, for example, from a given maximum tension to the same maximum in compression. Each specimen fails after going through a number of cycles of load fluctuation depending on the amount of load.

From these data a curve like Fig. 11 is plotted. Although this metal shows a tensile strength of well over 125,000 psi under steady load, it failed after 10,000 cycles of loading that varied from 80,000 psi in tension to the same value in compression. At 48,000 psi it failed after 100,000 cycles, at 33,000 psi after 1,000,000 cycles. At 30,000 psi, however, it still held after 100,000,000 cycles and presumably it would stand many more cycles of loading.

This material is described as having a *fatigue strength* of 80,000 psi at 10,000 cycles, 48,000 at 100,000, and 35,000 at 1,000,000 cycles. Its *endurance limit* is 30,000 psi at 100,000,000 cycles. Endurance limit can thus be defined as the highest stress that can be repeated indefinitely without failure. *Endurance ratio* is the endurance limit divided by the tensile strength, and varies from about 0.18 to 0.60 for different metals.

The environment in which the metal lives and works markedly affects the fatigue strength. If gas or fluid in contact with the metal produces corrosive effects, the metal is torn down progressively, leaving less and less cross section to carry the load. This deteriorating influence, added to that of fatigue cracks, rapidly reduces the useful strength of corrodible materials. In Fig. 11, if *A* represents the fatigue characteristic of a metal in air, then *B* might represent its behavior when exposed to corrosive fluids.



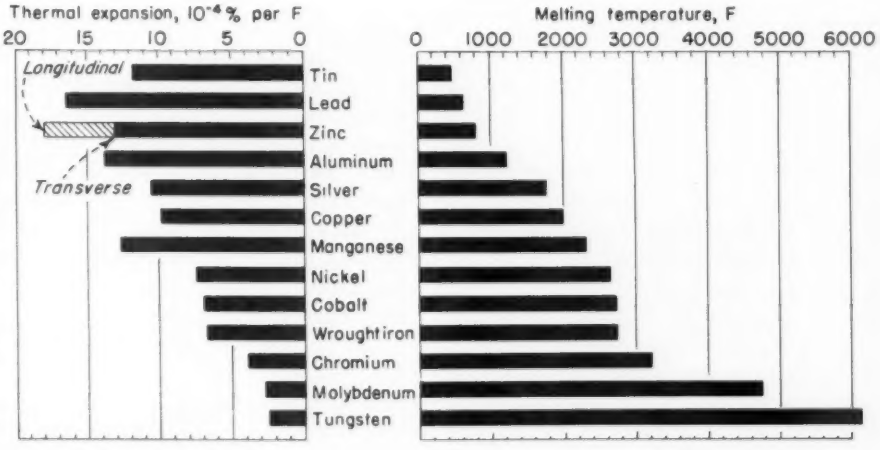
11 **Increasing number of cycles of variable stress loadings causes metal to rupture under smaller forces because of fatigue behavior. If *A* is the characteristic for a metal when it is in air, then *B* is its strength in corrosive fluid or atmosphere**

Temperature Effects

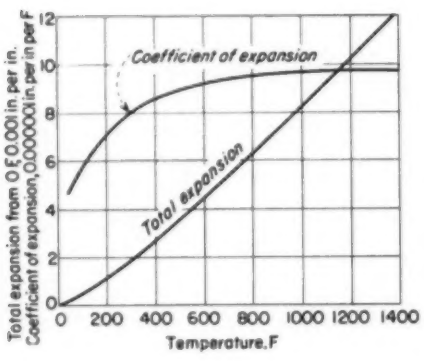
For designer and user, the effects of high temperature boil down to these four factors: (1) Metal expands. (2) Loss of strength is marked. (3) The all-important action known as *creep* takes place. (4) Corrosion and oxidation are accelerated. Let's look at these factors before detailing the kinds of metals that have been developed to resist high temperatures.

Thermal Expansion. All metals expand as temperature rises, but (1) rate of expansion varies from metal to metal, and (2) for any one metal, rate varies from one temperature level to another. *Coefficient of expansion* measures dimensional changes with temperature; it is expressed in parts of an inch per inch for any one dimension. Fig. 12 compares coefficients of various metals at room conditions. Because the coefficient changes with temperature, it is customary to give values for different temperature ranges when specifying metal characteristics.

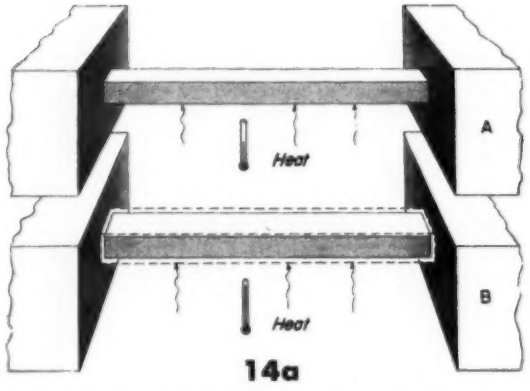
Expansion as temperature rises presents a problem because *thermal stress* may be set up. For example, consider Fig. 14, in which a metal bar just stays in place between immovable blocks at room temperature. If the bar is heated uniformly, it tends to expand as indicated by the dotted lines. Of course, thermal expansion takes place in *all* directions, but since, in this case, cross section is small relative to length we need consider only expansion parallel to the axis.



12 **Melting temperatures of metals vary widely, being relatively low for soft metals and high for hard ones. Coefficient of expansion is large for the softer metals**


Total expansion from 0 F, 0.001 in. per in.
Coefficient of expansion, 0.000001 in. per in per F
Coefficient of expansion
Total expansion
0 200 400 600 800 1000 1200 1400
Temperature, F

13 **Expansion coefficient of metals has different value at each temperature**



14 **Preventing a heated bar from expanding, *A*, creates thermal stress shown by graph. Heating beyond yield point, *B*, causes metal bar to take permanent set**

Being held rigid, however, the bar of the example cannot expand and compressive stress develops in the metal. The result is the same as if the bar, while free, had been heated to the given temperature and then compressed back to its original length. Compressive stress developed depends directly on amount of deformation or, with the bar restrained between blocks, on "prevented expansion."

Fig. 14*b* reveals further facts about thermal stresses. The bottom graph is an expansion-temperature curve like Fig. 13, while the upper is the metal's stress-strain curve. The graphs share a common ordinate, the *elongation* axis for the lower curve being also the *compression* axis for the upper one. This comes about because bar length is held constant.

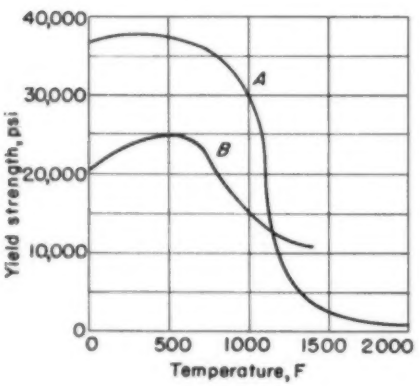
Starting at zero temperature, stresses in the bar build up as it is heated. Upon cooling from any upper temperature, which has produced stresses within the metal's elastic range, the bar returns to its original stress-free condition. Through the cycle of heating and cooling, length has not changed because of the restraining action of the blocks; the cross-sectional dimensions increase with heating and return to original conditions on cooling. Within this range, stress varies almost proportionally with temperature; the fact that the thermal-expansion curve is not quite a straight line causes a slight deviation.

Equivalent Hot-Working. If heating continues to temperature *B*, the stress passes through the metal's yield point and enters the ductile or malleable range. Perceptible growth in cross-sectional dimensions takes place although the blocks keep the bar length constant. It can be seen that this heating in the malleable range is equivalent to hot-working.

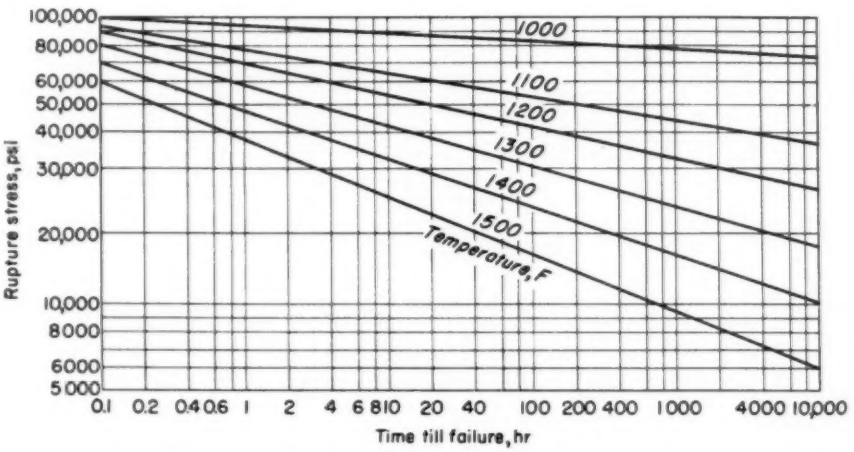
As temperature continues to rise above *B*, *rate* of stress increase falls off until the metal's ultimate strength is passed and subsequently the bar fractures. Around the region of ultimate strength, stress remains relatively constant with increasing temperature. Note that by raising temperature and preventing resulting expansion, we have produced in this metal bar the same sequence of stress and strain actions that would occur if bar were deformed at room temperature.

Moreover, if the bar is heated to *B*, and cooled, stress increases to *b* and then decreases along line *bO'* until it becomes zero, bar length remaining constant. Zero stress, however, is reached before original temperature is regained and continued cooling toward that point causes contraction below the bar's original length. If the bar were clamped in the blocks so length would remain constant under any conditions, the bar would be under tensile stress after it cooled below the temperature corresponding to O'. All this results from subjecting the bar to temperatures high enough to produce stress in the malleable range and a consequent permanent set.

Fig. 14 assumes that temperature variation does not alter the metal's



15 **Metal yield strengths vary with temperature. *A* loses strength fast if temperature increases. *B*, with lower initial strength, is more useful at high heats**



16 **Rupture strength at high temperatures depends on length of time stress is applied. Strength decreases rapidly with advancing time, increasing temperature**

stress-strain characteristics and this is sometimes true. Usually temperature affects the yield strength, as in Fig. 15. From the strength standpoint, metal *B* seems more suitable for high-temperature work than *A*, although it shows only about two-thirds the low-temperature strength.

The simplified example of the bar and blocks shows that temperature rise in metals causes expansion and that if expansion is restrained thermal stresses come into play. It cannot begin to show the complexities in actual machines, where metals with different coefficients of expansion must work side by side and where temperature distribution is not uniform. Couple with this condition the fact that most alloys for elevated temperatures show coefficients of expansion higher than common steels and you see one reason for high-temperature problems.

WHAT ABOUT CREEP?

It is safe to say that, in designing high-temperature equipment, the need for dealing with metals that undergo continuous slow deformation completely changes design thinking and procedures. While the power engineer never comes face to face with this problem, it is important that he know the fundamentals so that he understands the limitations creep imposes.

Creep. We have seen that, for many metals, yield strength at high temperature is less than at room temperature so an immediate effect that must be considered in high-temperature design is loss of strength. Yield strength is, however, measured by short-time tests and if metals are not stressed beyond their elastic limits under such conditions, even at elevated temperature they generally show no permanent deformation. On the other hand, if stress acts continuously at high temperature, metal behaves in a *plastic* fashion, deforming slowly and continuously in direction of applied force.

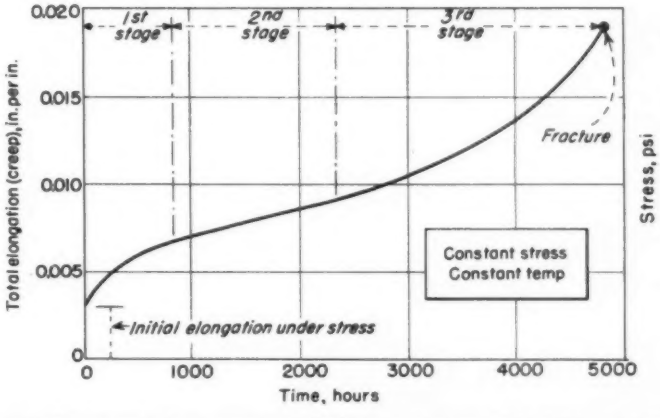
Fig. 17 shows how one metal behaves under tension at elevated temperature. When the constant stress is initially applied, the material elongates about 0.003 in. per in. But after 800 hr the elongation has increased (at a decreasing rate of increase with time) to about 0.007 in. per in. Elongation then increases uniformly to 0.009 in. per in. at 2400 hr. Rate of elongation increases again until fracture occurs at 4800 hr, with a total of 0.019 in. Thus, as in the graph, creep divides into three stages, each defined by the rate of deformation with time. Amount of creep and shape of creep-time curve vary from metal to metal.

Creep to Rupture. Fig. 16 shows the effect of time and temperature on rupture stress for one metal. At 1000 F the short-time rupture strength is 100,000 psi, but in six hours the metal fails at 90,000 psi, in 400 hr at 80,000, and in 10,000 hr at 72,000.

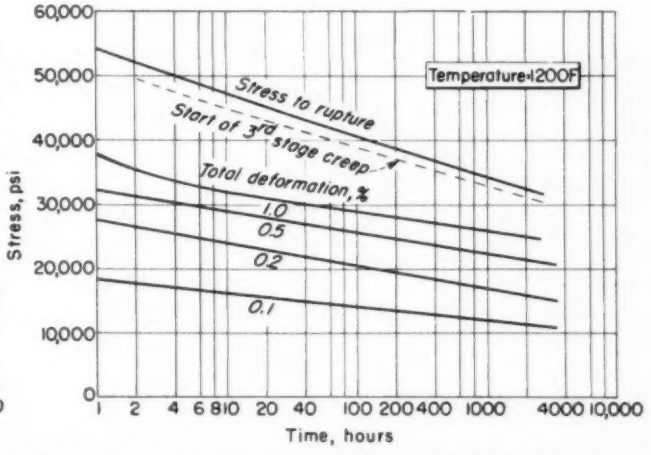
It can be seen that plastic deformation, or creep, introduces a new dimension — *time* — into the designer's problem. Thus in high-temperature work there are four factors — stress, strain, temperature and time — and for any one metal there is a fixed relationship between them within which the designer must work. For example, if a given machine part has to withstand a certain stress for a given number of hours without deforming more than a fixed amount, operating temperature cannot exceed a certain point. This 4-factor relationship explains why, for instance, a given material operates at about 1600 F in an aircraft gas turbine with a life measured in hundreds of hours, but only at, say, 1300 F in a land turbine intended to operate 100,000 hr. It is impossible to overemphasize the importance of this time factor—it governs all high-temperature design.

Design Curves. For the designer's convenience, test data plotted in Fig. 16 and 17 are summarized for each temperature value in the form shown in Fig. 18. (These three charts are for different metals and not interrelated. They merely show the *form* in which the results are used.) In Fig. 18 the upper stress-rupture curve is one of a family forming a plot like Fig. 16. The lower curves then define the related stresses and hours to produce a given total deformation. The smaller the allowable deformation, the lower the stress must be for a given service life.

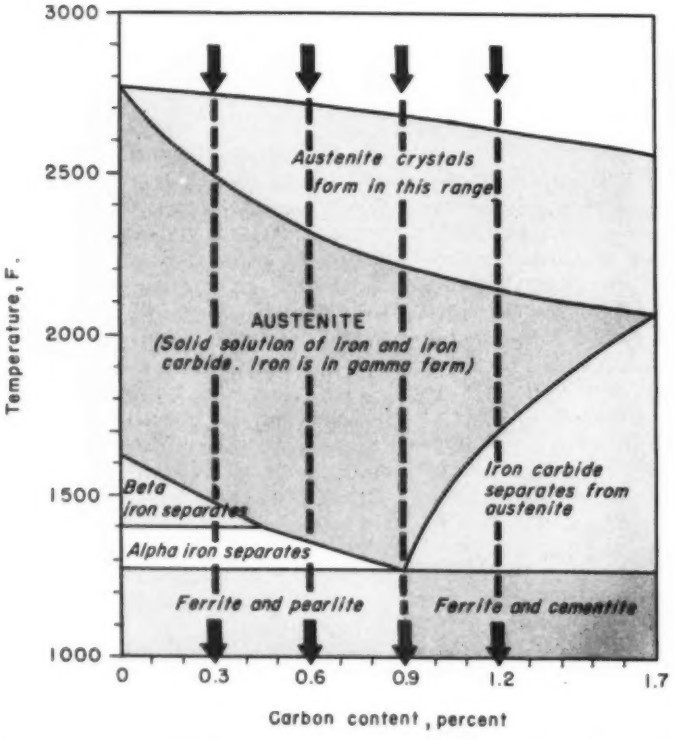
In proportioning machine parts, the designer may select a certain percentage of rupture strength after determining desired life. If use of the strength figure so obtained causes too great a deformation, he then tries the stress corresponding to the allowable deformation. For example, assume a machine part has a life of 1000 hr at 1200 F and is made of the metal whose creep characteristics are shown in Fig. 18. Safe working stress is taken as 60% of the rupture stress, but this particular part must not elongate more than 0.2%. In this case, safe working strength is 60% of 34,000 psi, or 20,400 psi. Interpolating between the curves at 1000 hr gives a deformation of 0.4%, which is too much. To maintain deformation within allowable limits, working stress must be reduced to 17,000 psi.



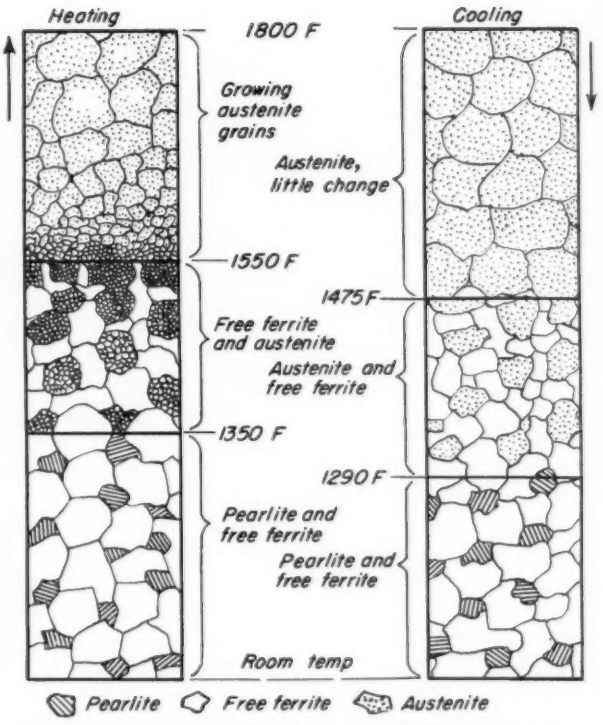
17 When metal at constant high temperature first becomes stressed it elongates at once, but as constant stress continues to act, metal proceeds to "creep" until final failure



18 These curves describe creep characteristic of a metal at one temperature. For a given life and operating temperature they show a designer what working strengths to choose



19 Alloy diagram for iron, carbon up to 1.7% shows state of any alloy at any temperature. Vertical dashed lines trace changes during cooling for alloys of different carbon content



20 Diagram pictures changes in nature and size of crystals of alloy with 0.25% carbon during slow heating and cooling. Temperatures at which changes occur are *critical points*

High-Temperature Alloys

Preceding pages outline the way metals behave under load and why special characteristics are needed for high-temperature service. To meet these needs, metallurgists have tried to develop alloys that retain their strength when heated, show low creep rates under continuous stress, and resist oxidation. The problem is infinitely complex, with many interlocking variables. All we can hope to do in limited space is trace some of the paths leading to the so-called "superalloys" of today, and list their properties.

Iron-Carbon Alloys. To understand how relatively small proportions of alloying ingredients produce large differences in metal properties, let's take a look at the alloys of iron and carbon. Pure iron, known as *ferrite*, is soft, but tough, ductile and malleable. The closest commercial approximation to pure iron is wrought iron, which is essentially ferrite with fibrous slag inclusions. Pure iron alloyed with relatively small quantities of carbon (less than about 1.7%) forms *steel;* with larger amounts of carbon it forms *cast iron.* The presence of iron-carbon compounds in various forms and amounts produces hardness in these metals.

In the molten state, the carbon of an iron-carbon alloy combines with some of the iron to form *iron carbide* (FeC_3). What happens when this liquid solution solidifies and cools down to room temperature depends on the carbon percentage. Metallurgists picture the changes that occur during the cooling of alloys of varying percentages by diagrams like Fig. 19, which is part of a complete iron-carbon chart.

Austenite Formation. Fig. 19 shows that liquid solutions of iron and carbon begin to solidify or "freeze" at about 2750 to 2600 F. Solid-solution crystals form and grow in the upper, lightly shaded area of the diagram. Like all solid solutions (see p 81) composition of these crystals is not fixed; concentration of iron and iron carbide varies from point to point. If cooling is slow enough, however, composition becomes uniform throughout, the proportions depending on the original percentage of iron and carbon. This solid solution of iron and iron carbide is *austenite.*

What happens on further cooling depends on the percentage of carbon. Lower edges of the austenite region on the diagram define the temperatures at which austenite begins to decompose. It can be seen that this temperature falls as the carbon percentage increases to about 0.9, and then starts to rise. Also, when carbon is less than about 0.9%, ferrite separates out of the austenite, whereas when carbon is higher than 0.9%, iron carbide separates out. This solid form of iron carbide is *cementite,* harder than glass and almost as brittle.

High-Carbon Alloy. Let's trace cooling of an alloy containing 1.2% carbon. Following the dashed line on Fig. 19, we see that as the alloy cools austenite forms and then, as temperature drops further, decomposes. Iron carbide separates out, which decreases concentration of iron carbide in remaining austenite. This continues until the austenite shows a carbon percentage of about 0.9% and the temperature reaches about 1275 F. At this point we have a mixture of *free* cementite formed by austenite decomposition, and austenite having 0.9% carbon, known as the *eutectoid* alloy.

On further cooling this remaining austenite breaks up into its constituents, ferrite and cementite. This usually occurs in the form of fine crystals, combining in a laminated structure

known as *pearlite*, which is quite soft. At room temperature, then, the resulting steel consists of about 95% pearlite and 5% of the extremely hard free cementite. Higher carbon percentage produces more cementite separation and hence harder steel.

Low-Carbon Alloys. Looking again at Fig. 19, cooling of an alloy with about 0.9% carbon is seen to follow a simpler path, all austenite decomposing into pearlite. At carbon percentages less than 0.9, cooling path becomes more complex. In this range, the austenite is high in iron so when it decomposes ferrite separates out, increasing iron-carbide concentration of the remainder. Final structure of alloys with less than 0.9% carbon is thus free ferrite and pearlite.

The diagram shows another fact—ability of pure iron to exist in several forms, depending on temperature. Iron in austenite is *gamma* iron. That which separates out of austenite above 1400 F is *beta* iron, and that which separates at lower temperatures and exists at room temperatures is *alpha* iron. All three are ferrite and chemically the same; differences in their crystal structure give different properties.

Cooling of an 0.3% carbon alloy shows transformation of iron. Austenite starts to decompose at about 1500 F, with ferrite separating out and taking the beta form. As temperature falls, further separation occurs. The ferrite coming out above 1400 F is transformed from beta to alpha iron when temperature drops below this point and ferrite separating below 1400 F goes directly into alpha form. In a 0.6% alloy, no beta iron forms, since austenite does not begin to break up until temperature is below that for beta iron.

HEAT TREATMENT

The changes taking place in alloys during slow cooling occur in reverse order on heating. If, after a 1.2% iron-carbon alloy is made and cooled to room temperature, it is heated, nothing happens until about 1250 F is reached. At this point the ferrite and cementite, which are only mechanically combined in the pearlite, dissolve in each other to form austenite. Further temperature rise puts the free cementite back into solution and when temperature reaches about 1650 F, the steel is all in the austenitic form.

Structure Changes. Fig. 20 pictures changes in nature and size of crystals of a 0.25% carbon steel on slow heating and cooling. Note that austenite grains grow in heating but do not get smaller in cooling. Also, temperatures at which changes occur (called critical points) differ between heating and cooling.

So far we have considered only slow heating and cooling, which gives time for the structural changes to occur. Rapid cooling such as results from quenching in water tends to arrest the changes at an intermediate point. For example, slowly cooled austenite decomposes to pearlite and ferrite or cementite, but if quenched, decomposition is stopped and a structure known as *martensite* results. It is harder than austenite and the heating and quenching that produces it is commonly referred to as *hardening*.

Austenite and intermediate forms such as martensite are unstable at low temperatures and if the molecules are given a little mobility by heating, even to temperatures below the critical point, decomposition will begin. It is thus possible to reduce the brittleness of hardened steel by heating, carefully controlled to produce further pearlite formation. This is known as *tempering*. Full heating to temperatures above the critical points and slow cooling, which produces complete decomposition of austenite to pearlite and ferrite or cementite, is known as *annealing*.

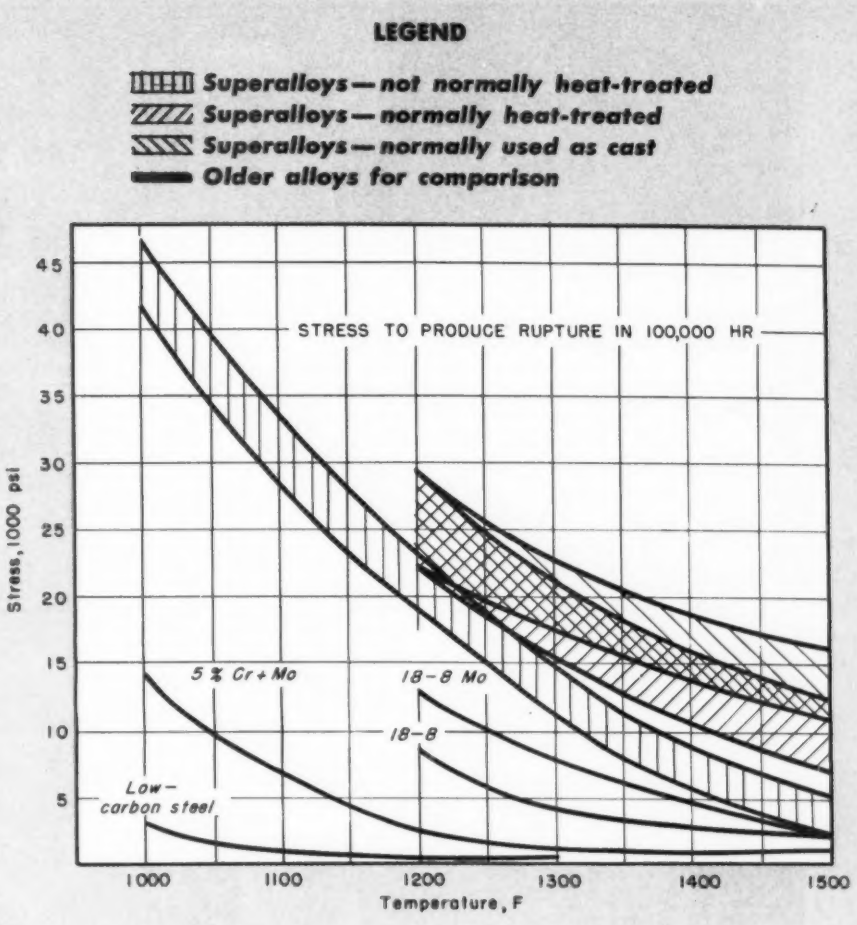
Although we have only scratched the surface of behavior of alloys, we can now see two of the main paths by which metallurgists effect control of metal structure and hence service characteristics: (1) adjusting percentage of alloying elements, and (2) heat treatment.

We have seen that steel is an alloy of iron and carbon. If other elements are added, nickel for instance, we have an *alloy steel*. Usually several elements are added, each to produce a specific effect. Added elements may combine with iron or carbon by: (1) dissolving in both liquid and solid states of iron to be retained in solid solution at room temperature (2) combining with carbon or iron carbide to form compounds (3) remaining undissolved, merely mixed with the steel.

Most of the commonly used alloy steels contain relatively small percentages of the alloying elements. Effects of such additions are summarized as:

Nickel enters into solid solution, lowering critical points to a marked degree. It tends to retard rate of grain growth at high temperatures, strengthens ferrite, increases resistance to cor-

HIGH-TEMPERATURE PROPERTIES OF VARIOUS ALLOYS



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TYPICAL COMPOSITIONS AND PROPERTIES OF

Alloy name	Producer	Iron	Chromium	Nickel	Cobalt	Molybdenum	Tungsten	Manganese	Silicon	Columbium	Titanium	Others	Carbon	Condition on which mechanical properties are reported opposite
Carbon–moly		98.5				0.50		0.75	0.3				0.10-0.20	Data on mechanical properties from Timken Digest of Steels
Chrome–moly		93.0	5.0			0.50		0.60	0.75				0.10+	
18-8		70.4	18.5	9.5				1.00	0.50				0.07	
18-8 Mo		66.2	17.0	12.0		2.00		2.00	0.75				0.10	
18-8 Cb		68.2	18.5	11.0				1.00	0.50	0.70			0.07	
18-8 Ti		70.9	18.5	8.5				0.75	0.75		0.50		0.10	Allegheny-Ludlum data
25-12		59.3	24.0	14.0				1.00	1.25			0.12 N	0.35	Data from Timken
25-20		51.4	25.0	20.5				1.25	1.75				0.12	Digest of Steels
Inconel	International Nickel Co	6.7	13.0	79.5				0.25	0.25			0.2 Cu	0.09	
SUPERALLOYS — NORMALLY USED WITHOUT HEAT TREATMENT														
19-9W-Mo	Universal-Cyclops Steel Co	68.4	19.0	9.0		0.40	1.25	0.60	0.50	0.40	0.35		0.10	Hot-rolled and stress-relieved
19-9 DL	Universal-Cyclops (and others)	67.2	19.0	9.0		1.25	1.25	0.75	0.50	0.40	0.35		0.30	Hot-worked disk, stress-relieved at 1200 F
19-9 DL[12]														
17-W	Universal-Cyclops Steel Co	62.3	13.0	20.0		0.60	2.25	0.60	1.00				0.30	Annealed
Gamma columbium	Allegheny-Ludlum Steel Corp	49.6	15.0	25.0		4.00		1.00	1.00	4.00			0.40	Annealed
16-25-6	Timken Roller Bearing Co	50.5	16.0	25.0		6.00		1.50	0.75			0.15 N	0.09	See footnotes 3 and 4
16-25-6[13]														
SUPERALLOYS — NORMALLY HEAT-TREATED														
S-588[9]	Allegheny-Ludlum Steel Corp	48.2	18.0	20.0		4.00	4.00	0.75	0.65	4.00			0.40	1 hr at 2250 F, H_2O quench–aged 16 hr at 1400 F
Discaloy	Westinghouse Electric Corp	55.5	13.0	25.0		3.00		0.70	0.70		1.80	0.2 Al	0.05	1 hr at 1950 F, Furn cooled–aged 20 hr, 1350 F
N-153[7]	Haynes Stellite–Universal-Cyclops	49.9	16.0	15.0	13.0	3.00	2.00			1.00			0.10-0.20	
N-155[7]	Allegheny-Ludlum–Crucible Steel	33.7	20.0	20.0	20.0	3.00	2.00			1.00		0.12 N	0.10-0.20	Hot-worked disk, stress relieved at 1200 F
S-590	Allegheny-Ludlum Steel Corp	24.6	20.0	20.0	20.0	4.00	4.00	0.75	0.65	4.00		1.65 Al	0.40	1 hr at 2300 F, H_2O quench–16 hr at 1400 F, a-c
Hastelloy C	Haynes Stellite Co	5.0	15.0	59.0		17.00	4.00						0.10	
Hastelloy B	Haynes Stellite Co	5.0		66.9		28.00							0.10	S-t at 2000 F, H_2O quench–aged 4 hr at 1200 F
K-42-B	Westinghouse Electric Corp	14.0	18.0	42.2	22.0			0.70	0.70		2.2	0.2 Al	0.05	1 hr at 1950 F, oil-cooled–aged 20 hr at 1350 F
Refractaloy 26	Westinghouse Electric Corp	18.0	18.0	37.0	20.0	3.00		0.70	0.70		2.8	0.2 Al	0.05	1 hr at 2100 F, a-c–aged 20 hr, 1500 F; 20 hr, 1350
Inconel X	International Nickel Co	7.0	15.0	73.0				0.50	0.40	1.00	2.50	0.7 Al	0.04	4 hr, 2100 F, a-c–24 hr at 1550 F a-c; 20 hr, 1300 F a-c
Talbot alloy	International Nickel Co	27.4	20.0	50.0				0.40	0.60	0.60	0.25	0.25 Cu	0.50	As cast
Refractaloy 70	Westinghouse Electric Corp	15.0	20.0	20.0	30.8	8.00	4.00	2.00	0.20				0.05	4 hr at 2350 F, oil-cooled–240 hr at 1500 F
S-816	Allegheny-Ludlum, Crucible Steel,	4.0	20.0	20.0	43.0	4.00	4.00	0.50	0.50	4.00			0.40	Same as S-590
S-816[9]	Universal-Cyclops													As cast
SUPERALLOYS — NORMALLY USED AS CAST														
Vitallium (HS 21)	Haynes Stellite Co–Austenal	1.0	28.0	2.0	62.8	6.00							0.20-0.30	As cast[10]
61 (HS 23)	Haynes Stellite Co	1.0	28.0	2.0	62.6		6.00						0.40-0.50	As cast[10]
6059 (HS 27)	Haynes Stellite Co	0.6	28.0	32.5	32.5	6.00							0.40-0.50	As cast[10]
422-19 (HS 30)	Haynes Stellite Co		28.0	16.0	49.6	6.00							0.40-0.50	As cast[10]
X-40	Haynes Stellite Co		28.0	12.0	52.1		7.50						0.45-0.55	As cast[10]

GENERAL NOTES: The names given to various alloys are those commonly used; other designations are often applied by the makers and by organizations issuing codes and standards. Producers are listed only where the alloy is exclusive with one or several makers. Compositions given are nominal; usually content of individual elements varies within a narrow range. Base of each alloy is indicated by the figures in white on a green background. For any one alloy a number of heat treatments can be employed to improve various properties; those listed are typical and indicate the condition of the metal used in determining the mechanical properties listed. Test results on similar specimens may yield substantially different results; values given are indicative only.

To give a full picture of high-temperature properties, data over a wide range of temperatures are needed, but to meet space limitations, listing here is confined to the 1200 and 1500 F levels, as being of most current interest. Creep data are reported for the relatively short time of 1000 hours because most tests

rosion and fatigue failure, improves toughness. Value of nickel as an alloying element is emphasized by addition of others, such as chromium.

Chromium dissolves in both gamma and alpha iron, but combines with carbon to form an extremely hard carbide. Chromium thus imparts hardness, and is universally used to improve resistance to corrosion and oxidation.

Manganese is always added to steel, showing both direct and indirect benefits. It tends to tie up any sulphur that is present. It has only a mild tendency to combine with carbon and dissolves in ferrite, strengthening it.

Tungsten dissolves in iron, and forms a carbide with cementite. As these complex carbides are extremely hard, they tend to improve retention of strength and hardness at high temperature.

Molybdenum also dissolves in iron, and forms carbides in the presence of carbon. Like tungsten, it improves hot strength and hardness, and reduces tendency to grain growth at high temperature. It finds wide use as a supplementary element.

Silicon, present in all steels as a result of manufacture, dissolves in gamma and alpha iron, and does not form carbides.

These common alloying elements, and others less widely used because of relatively high cost, give plenty of scope to the metallurgist in tailor-making alloys for specific service conditions. At the same time, the very variety of possible combinations complicates the problem, since it is not possible to predict the effect of a combination of several alloying elements as easily and accurately as the effect of carbon percentage in an iron-carbon alloy. Thus trial and error plays a part.

Conflicting requirements often further complicate devising a new alloy. A given combination must lend itself to economical manufacture and metallurgical control, be suitable for fabrication by a variety of commercial processes, and meet service conditions that often call for contradictory qualities. Thus, a given combination producing needed service characteristics may have to be modified and some service-suitability sacrificed because of limitations in manufacture of the alloy or in its fabrication. Most alloys, therefore, represent compromises and often the difference between two compositions reflects differing views on importance of certain qualities.

Economic factors also enter. Often desired qualities are most readily

ALLOYS FOR HIGH-TEMPERATURE SERVICE

Alloy name	Coefficient of expansion, in. per in. x 10^6			Short-time strength—room temp				Short-time strength—1200 F				Endurance strength, psi at 10^8 cycles		Creep—1200 F		Creep—1500 F	
	70 F to 600 F	70 F to 1000 F	70 F to 1500 F	Ultimate strength, psi	0.2% yield strength, psi	Elongation, % in 2 in.	Modulus of elasticity x 10^6	Ultimate strength, psi	0.2% yield strength, psi	Elongation, % in. 2 in.	Modulus of elasticity x 10^6	1200 F	1500 F	Stress to rupture in 1000 hr, psi	Stress for 1% creep rate in 1000 hr, psi	Stress to rupture in 1000 hr, psi	Stress for 1% creep rate in 1000 hr, psi
Carbon–moly				64,100	32,500	37.0		28,100	15,100	56.0				5,000			
Chrome–moly		7.10		66,600	26,250	39.0		25,800	11,300	46.0				6,000		1,500	
18-8		10.38		82,500	30,500	61.5		43,000	11,000	37.0				11,500		3,500	
18-8 Mo														25,000		7,000	
18-8 Cb		10.02		91,750	41,500	46.0		48,750	25,500	44.0				20,000			
18-8 Ti		9.5		80,000	30,000	56.0	29.0	46,100	22,800	25.0							
25-12		9.71		93,600	44,000	49.5		50,000	20,000	23.0				20,000		5,900	
25-20		9.64		87,400	36,000	54.0		58,000	20,000	21.0				18,000		4,800	
Inconel	8.00	8.28	8.75	90,500	36,700	47.0	31.0	61,000	26,700	38.0	20.0	36,000	13,000	12,000		4,400	
SUPERALLOYS — NORMALLY USED WITHOUT HEAT TREATMENT																	
19-9W-Mo					65,000		30.0		33,000	27	21.0	40,000		34,000			
19-9 DL	9.31	9.78	10.01	105,250	54,000	34.0		57,875	37,900	34.0				35,000	26,000[1]		
19-9 DL[13]				140,000	115,000	19.0											
17–W				109,300	48,250	39.0		69,250	28,000	17.0				29,000			
Gamma columbium				108,000		37.0								36,000		11,000	
16-25-6	8.85	9.20	9.5[2]	109,000[3]	52,000[3]	49[3]	32.5	90,000[4]	75,000[4]	12[4]	17.9[4]			33,000	22,000	10,000	7,000
16-25-6[13]				120,000	100,000	20											
SUPERALLOYS — NORMALLY HEAT-TREATED																	
S-588[9]	8.38	8.65	9.34	140,000	80,000	5.0	29.0	81,350	57,750	18.1	18.6			32,000	25,000	10,400	9,500
Discaloy	9.10	9.50		145,000	106,000	19.0		104,000	91,000	16.6				50,000	48,500[1]		
N 153	9.21	9.51	9.78														
N 155	8.70	9.10	9.77											42,000	35,000[1]	13,500	12,000[1]
S-590	7.60	8.00	8.30[2]	140,000	42,000[4]	20	29.0	81,600	49,000[4]	27	16.0		33,000	40,000	34,000	15,000	14,000
Hastelloy C	7.02	7.44	8.07	81,200	50,800	10.2[6]	24.5	67,200		15.5[6]		66,000				10,700[12]	
Hastelloy B	6.41	6.66	6.96	84,000	57,800	11.9	28.5	68,700		14.7		66,000	34,000	36,500[11]		10,000[11]	
K-42-B	7.80	8.30		158,500	100,000	24.0		110,200	91,000	8.0[6]		58,000	29,000	40,800		10,500	
Refractaloy-26	8.00	8.20		154,000	95,000	18.0[6]		135,500	94,000	14.0[6]		52,000				18,100	16,100[1]
Inconel X	7.90	8.20	9.06	167,000	102,000	21.0	31.0	120,000	79,000	11.0	23.0	53,000	35,000	69,000		18,000	17,000
Talbot alloy	7.8	8.2	9.30	85,000	55,000	5.0	26.0	70,000	40,000	6.0						13,000	12,000
Refractaloy-70	7.80	8.3	8.90	132,000	87,000	3.0[6]		112,000	72,000	11.0[6]			32,000	42,000	28,800[1]	15,000	14,800[1]
S-816	6.60	7.1	7.70[2]	159,000	68,000[5]	21.0	30.0	120,000		17.0	15.0	68,000	33,000	50,500	41,000	19,000	17,000
S-816[9]				95,500	73,500	6.0	31.0							47,000		18,500	17,500
SUPERALLOYS — NORMALLY USED AS CAST																	
Vitallium	7.83	8.18	8.68	101,300	82,300	8.2	36.0	71,000	35,600	18.4	33.7	44,000	33,000	44,200		14,200	
61	7.64	8.18	9.24	111,000	86,800	8.7	29.0	82,900	40,700	15.6	33.5	44,000	38,000	47,000		21,800	
6059	7.53	8.04	8.67	90,800	65,200	12.7	28.0	48,900	35,000	3.8	27.0	41,000	31,000	46,000		18,400	
422-19	7.70	7.91	8.42	96,900	81,100	10.0	27.0	59,900	37,600	6.3	27.5	52,000	42,000			23,500	
X-40	7.97	7.98	8.43	113,000	79,500	8.0	36.0	77,000	37,600	19.0	22.8	56,000	46,500	46,000		23,500	

have, of necessity, been short-time. In design work, short-time data are frequently extrapolated for longer service-life requirements.

SPECIFIC NOTES: (1) Creep stresses so designated are those producing 1% *total deformation* in 1000 hr rather than those producing a 1% secondary creep rate in 1000 hr. (2) Coefficient of expansion for 70 to 1400 F. (3) Properties so designated are for hot-rolled bar, solution-treated at 2150 F and water quenched. (4) Solution-treated at 2150 F, cold worked, tempered at 1250 F. (5) Yield strength at 0.02% offset. (6) Elongation, % in 1 in. (7) Available also with higher carbon content. (8) Replaces S-495. (9) Used as cast alloy, same composition as wrought. (10) Some values obtained on specimens aged 50 hr at 1350 F. All precision-cast test specimens. (11) Values obtained on wrought specimen heat-treated for 30 min at 2125 F, air cooled, aged 72 hr at 1700 F, air cooled. (12) Value obtained on a sand casting. (13) Values obtained from specimens taken across longitudinal axis of 400-lb turbine disk forged from ingot made by continuous-casting process.

gained by adding relatively costly elements. Usually the user must judge whether the gain in properties justifies extra cost. Higher cost per pound may be accompanied by higher cost of fabrication, further influencing the decision. Thus development and application of specialized alloys follows no single, simple path. Engineering judgment enters at all stages, as the variety of alloys in the table above indicates.

Early development of alloys for high-temperature service centered to a great extent on applications where strength was not a major criterion and where resistance to oxidation was of most importance. Chromium-nickel-iron and nickel-base chromium alloys give excellent results in such cases.

Advent of higher temperatures in steam power plants and oil refineries led to need for metals capable of retaining strength at temperatures above 750 F and showing relatively low creep rates. Carbon-molybdenum steel found wide use for power piping before the war, for temperatures up to about 900 F, as did chrome-moly in refineries. Later evidence (p 93) indicates carbon-moly was over-extended, but it stands as predecessor of today's alloys.

In prewar years a substantially different class of steels was developed, which showed considerably better strength and creep characteristics at high temperatures. When the demand came for these properties in superchargers and jet engines, where cost was not a limiting consideration, these steels formed the basis for the first group of so-called superalloys. Let's examine their characteristics briefly.

Austenitic Alloys. Addition of fairly large percentages of nickel and chromium to steel tends to lower the temperature at which austenite decomposes into pearlite and either ferrite or cementite. Familiar "stainless" steels (roughly 18% chromium and 8% nickel) display an austenitic structure at room temperature as well as high resistance to corrosion and oxidation at moderately elevated temperatures. These alloys cannot be hardened by heat treatment nor does heating and cooling materially affect the structure, a behavior markedly different from that of ordinary carbon steels.

A most important characteristic of many *austenitic steels* is their ability to *work harden*. Application of external force, as in forging, rolling or drawing, deforms the crystal structure, setting up internal stresses. This energy locked in the distorted crystal structure improves strength.

If a work-hardened alloy is heated to a temperature high enough, *recrystallization* occurs, that is, internal stresses resulting from prior deformation are relieved and crystals return to the undeformed, or annealed, condition. It can be seen that for successful high-temperature use, recrystallization temperature of such an alloy must be substantially above temperatures met in service. Addition of carefully balanced amounts of elements such as molybdenum and tungsten assures this.

Stainless steels are often "stabilized" by addition of small amounts of titanium or columbium, which tend to prevent precipitation of chromium carbides and resulting intergranular corrosion. In larger percentages, and with higher carbon content, they tend to form complex carbides and other phases, which, when dispersed through the structure and especially at grain boundaries, serve as mechanical "barriers," restraining grain growth and loss of internal energy from working.

Thus, growing out of the original stainless steels, and stainless steels stabilized with small amounts of titanium and columbium, we have a group of superalloys that are basically nickel-chromium-iron steels with relatively complex compositions often including substantial percentages of molybdenum, tungsten, titanium and columbium. As indicated in the table of compositions and properties, they are normally used without conventional heat treatment and depend almost entirely upon work hardening for high-temperature strength. Work hardening of these superalloys usually takes place at temperatures somewhat below those met in forging and rolling. This action is thus often referred to as "hot-cold" work.

Precipitation Hardening. Work hardening imposes limitations, since the forces required to work large pieces, such as rotors, may prove excessive for normal forging or rolling equipment. It may prove difficult to secure uniform distribution of hardness throughout irregular sections. Since machine operations normally follow working, machining is apt to be difficult. There has thus been a parallel effort to develop alloys that can be hardened by heat treatment alone, or by a combination of working and aging. Alloys of this general type are grouped in the table. Note that Hastelloy B and C are essentially prewar materials with characteristics of this class.

The principle of *age hardening* or, more accurately, *precipitation hardening*, is usually relied on to produce high-temperature strength in this group. In the iron-carbon alloys, we saw that solubility of carbon in iron depends on temperature. A somewhat similar mechanism is employed in precipitation-hardening alloys.

For example, the element titanium forms complex compounds which display variable solubility. For a given percentage of titanium, there is a certain temperature above which these compounds are soluble. If quenched or cooled rapidly enough from this temperature, they remain completely dissolved. This solid-solution state is unstable, and heating to a temperature below the *solution temperature* causes precipitation of these titanium compounds, which distribute themselves through the metal structure and in so doing increase strength and hardness. Time is required for completion of this action, hence the term "aging."

Precipitation-hardened alloys normally receive *solution treatment* first; the alloy is heated to a temperature in the solid-solution range (1900-2400 F) and quenched or otherwise cooled. Hardening is then induced by exposure to a lower temperature (1200-1500 F) for a period ranging anywhere from one to several hundred hours. The hardening agent, or agents, are selected so *aging temperature* is near service temperature; if service temperature is much higher than aging temperature, *overaging* occurs in service, with consequent loss of hardness and strength.

Basic structure into which the hardening agent precipitates is usually austenitic. Various combinations of chromium, iron, nickel and cobalt may be employed, since all go into solid solution. With a few exceptions in the nickel-base group, all these alloys contain relatively large percentages of chromium (13-20%) for corrosion and oxidation resistance. Relative percentages of iron, nickel and cobalt depend to a large extent on economic considerations, iron being relatively inexpensive and easy to introduce into the melt. A minimum of about 15-20% nickel is essential to produce the stronger austenitic structure; higher percentages tend to improve mechanical properties, as does cobalt, which appears to improve ductility and forgeability. Choice of hardening agents depends on many factors; titanium, columbium, tungsten and molybdenum are among elements that may be used.

Casting Alloys. The group of superalloys normally heat treated before use are, in the main, designed to be wrought, although all can be cast. Third group of alloys in the table have characteristics leading to their use in cast form, normally without heat treatment. Percentage of cobalt is high (30-63%) and chromium content is essentially constant at 28%. Nickel content varies from 2 to 33%. Either molybdenum or tungsten is present in amounts ranging from 5 to 7.5%. Iron content is negligible, these being essentially nonferrous alloys.

Metallurgy of this group is complex. Briefly, these alloys consist essentially of a variety of extremely hard complex compounds distributed in a metallic structure. This structure, while responsible for their excellent high-temperature strength, particularly in respect to creep, makes working and machining by normal methods extremely difficult. Development of precision casting (see POWER, July 1946, pp 95, 98) makes their use possible in cast form with little or no finishing. It is interesting note that, in general, cast alloys are superior to wrought alloys in resistance to creep.

European Developments. The table above lists compositions of typical British and German high-temperature alloys. Evidence indicates that German alloys were, in general, inferior to U.S. and British, probably because increasing shortages of nickel, tungsten, molybdenum and finally of chromium made it necessary to abandon promising approaches. This led to manganese steels such as Cromadur, and substitution of vanadium, as in Vanidur.

TYPICAL EUROPEAN HIGH-TEMPERATURE ALLOYS

Alloy Name	Iron	Chromium	Nickel	Cobalt	Molybdenum	Tungsten	Manganese	Silicon	Columbium	Titanium	Others	Carbon
British alloys:												
R20	64.1	19.0	14.0				0.80	0.30	1.70			0.14
Rex 78	58.4	14.0	18.0		3.75		0.80	0.70		0.65	3.6 Cu	0.07
G18B	54.3	13.0	13.0	10.0	2.00	2.50	0.80	1.00	3.00			0.40
R22	54.8	25.0	14.5			3.20	0.90	1.30				0.30
Nimonic 80		21.2	74.2				0.56	0.47		2.44	0.63Al	0.04
German alloys:												
V2A-ED	70.5	18.0	9.0			1.00	0.50	0.50		0.40		0.10
Cromadur	68.3	12.0					18.00	0.70		(0.7V, 0.2N)		0.10
Vanidur	69.5	17.5	10.5				0.30	0.40		0.60	1.0V	0.10
Tinidur	52.0	14.0	30.0				0.80	0.80		2.30		0.10
DVL 42	11.2	14.5	36.9	24.5	5.30	4.80	0.90	0.55		1.30		0.07

High-Temperature Design

High - temperature design involves not one but many problems. In a superheater tube, for example, expansion and elongation due to creep can be allowed for with no great trouble, but loss of strength, as reflected in need for thicker tube walls, must receive consideration, as must oxidation and corrosion. In a turbine wheel, on the other hand, close clearances put a strict limit on creep, and fatigue is important. Because stresses result largely from centrifugal force, heavier construction does not prove a satisfactory answer.

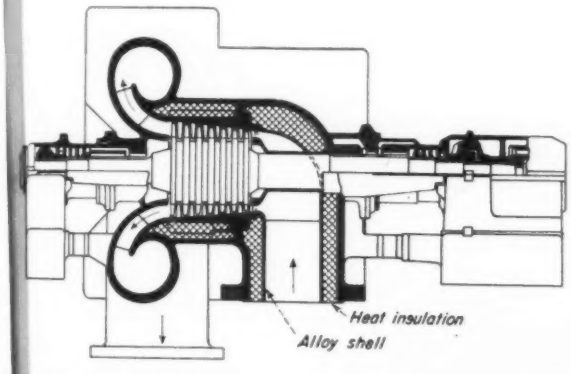
In high-pressure piping, wall thickness can be increased within reasonable limits, but expansion presents a definite problem and any metal used needs to be adaptable to welding under field conditions. In high-temperature valves, differential expansion may work against tight seating.

These examples illustrate some considerations in high-temperature design and how they may vary in importance from application to application. Recent experience with carbon-moly pressure piping further illustrates the inter-relation of design factors.

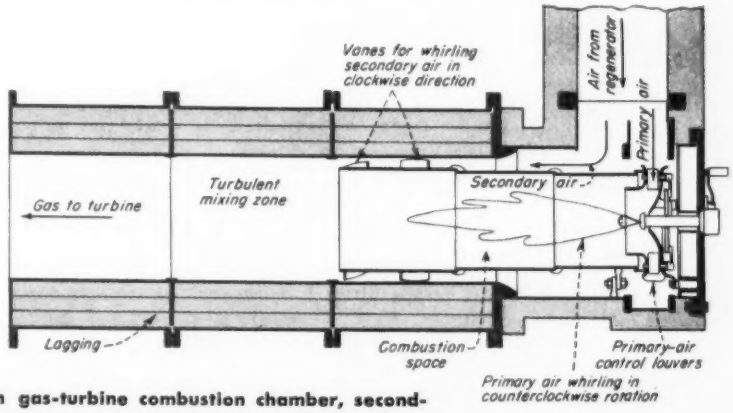
Carbon-moly found wide use before the war for temperatures up to 900 F because it combined good welding properties with enough creep strength to permit holding wall thickness to reasonable limits. Failure near a weld in a line operated for 5½ years at slightly above 900 F (1500 psi) led to discovery of graphite segregation caused by welding. Ductility was lost in the area of *graphitization*, and shock failure resulted. Examination revealed graphitization in other parts of the same line and in other plants. Investigations indicated that it resulted from use of aluminum to deoxidize the steel, a necessary step in producing seamless pipe.

Addition of chromium markedly reduces rate of graphitization and today's specifications for 900-950-F piping and valves usually call for ASTM A-280 steel (0.50-0.70% chromium, 0.45-0.65% molybdenum and 0.10-0.20% carbon). Higher chromium content (0.80-1.10%) seems indicated for temperatures above 950 F, but welding properties of such an alloy are questioned. Strict control of carbon content

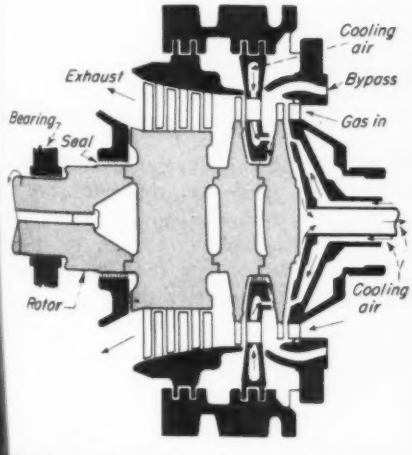
HOW INGENIOUS DESIGN MINIMIZES TEMPERATURE EFFECTS



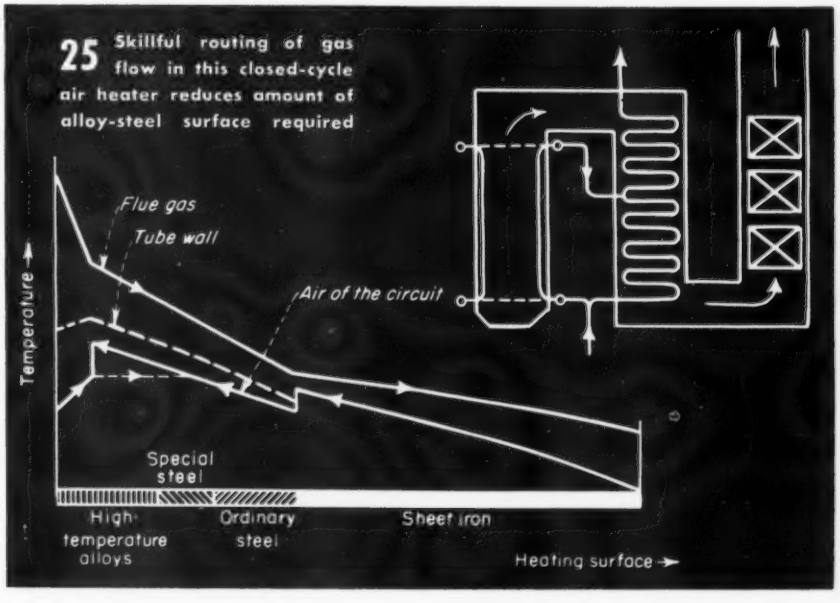
22 Only inner lining of double turbine casing has to stand high temperature



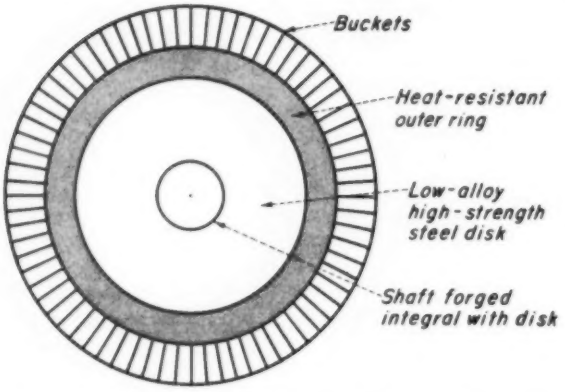
23 In gas-turbine combustion chamber, secondary air holds flame-tube temperature down



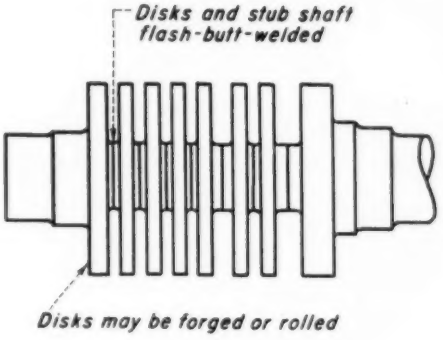
24 Cooling air blows against the first-stage disk of this gas-turbine rotor



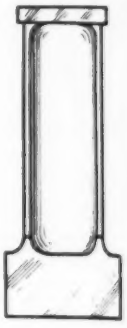
ADAPTATION OF DESIGN TO ABILITIES AND LIMITATIONS OF METALS



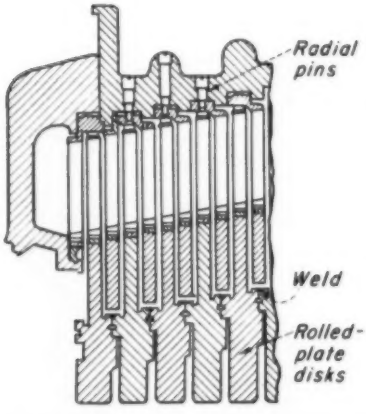
26 Composite turbine-disk construction puts high-temperature alloy at rim, high-strength alloy at center, as needed



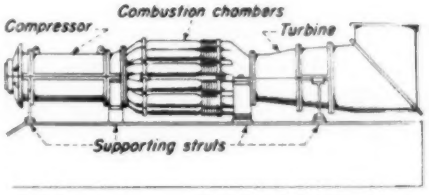
27 Large rotors, impractical to forge of high-temperature alloys, may be built up of flash-butt-welded elements



28 Precision casting makes supercharger blade of high-temperature alloy impractical to machine



29 Section of a gas-turbine rotor and casing shows the radial pins used to provide for differential expansion between the diaphragms and casing. Rotor is built up of disks made from cross-rolled plate, welded circumferentially, as indicated in drawing



30 In-line gas-turbine design is mounted to allow for expansion yet maintain alignment. The end struts can deflect axially, side struts laterally. Note expansion joints at each combustion chamber

and revised welding techniques seem necessary when the next temperature advance calls for such alloys.

In working out the high-temperature problems of gas turbines and jet engines, designers follow two main lines of attack. They first seek to reduce temperature load on the metals by, for example, air cooling, Fig. 23 and 24. As a corollary, they design to cut the amount of high-temperature alloy required, as in double turbine casing of Fig. 22 and gas-flow circuit of closed-cycle gas-turbine air heater, Fig. 25.

The second line of attack lies in adapting design to take full advantage of the particular abilities of the high-temperature alloys and to minimize the effects of their definite limitations. A typical example is the composite gas-turbine disk shown schematically in Fig. 26. The rim, of high-temperature alloy, is welded to the forged central section of low-alloy high-strength steel suitable for operation below about 700 F. Exhaustive testing indicates no difficulty from thermal expansion. A recently developed continuous-casting process offers the possibility of making an electric ingot having a low-alloy core, with a high - temperature - alloy outer layer molecularly bonded to it. From such an ingot, a composite wheel could be forged directly.

The difficulty of making large forgings of high - temperature alloys has been mentioned. This has led to a variety of designs utilizing built-up constructions, with rolled or forged elements welded together, Fig. 27, 29.

Precision casting, as widely used for supercharger and gas-turbine blades and buckets, Fig. 28, offers a potent means of using high - strength alloys whose nature makes extensive working or machining impracticable. With further development in metallurgical control of such casting operations, it seems likely that qualities of cast alloys will be more fully appreciated as service temperatures approach levels at which metals are commonly wrought.

Both total and differential expansions pose severe problems at high temperatures. Fig. 29 shows one feature of "heat-elastic" construction employed in a marine gas turbine. Use of radial pins maintains alignment while allowing differential expansion between diaphragms and casing. Another example of taking care of expansion while maintaining alignment is illustrated in Fig. 30, where an "in-line" gas turbine is supported on a system of struts. End struts deflect to take axial expansion, while side struts deflect for lateral expansion.

These examples, while representing only a few of the many design devices developed by engineering ingenuity, serve to show that the task of successfully utilizing high temperatures lies as much with the engineer as with the metallurgist. They round out the picture of a problem so complex that each small step forward represents a tremendous achievement.

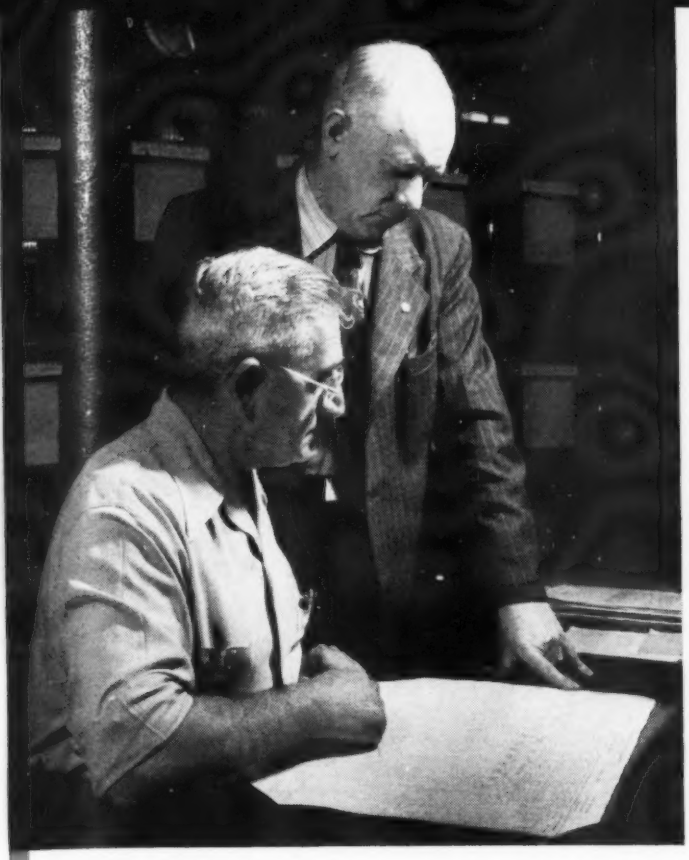
ACKNOWLEDGMENTS

In preparing this special section we have drawn freely on the published literature of the metallurgists and designers. In particular, we wish to express appreciation to the following organizations for specific data and assistance: Allegheny-Ludlum Steel Corp, Allis-Chalmers Mfg Co, Battelle Memorial Institute, Crucible Steel Co, Elliott Co, General Electric Co, Haynes Stellite Co, International Nickel Co, M W Kellogg Co, Timken Roller Bearing Co, Universal-Cyclops Steel Corp, Westinghouse Electric Corp.

Three good reasons why he achieved his goals are constant study of power engineering through night school and correspondence courses, 20 years of progress with one organization, and loyal service in NAPE activities

JOSEPH P FLYNN

Supervisor of Ventilating and Control Equipment of Holland Tunnel, President of NAPE



Joseph P Flynn (standing) checks daily log sheet where traffic conditions and CO content are entered hourly

▶ THE NEWLY ELECTED NATIONAL PRESIDENT of National Association of Power Engineers, Joseph P Flynn, is also senior supervisor of ventilating and control equipment for the Holland Tunnel. He directs the vast network of services that keep this large utility functioning smoothly. The tunnel contains the longest pair of vehicular tubes in the world, one for eastbound traffic under the Hudson River, and the other for westbound. The Port of New York Authority operates it.

Handling more than 40,000 vehicles a day, the tubes require huge quantities of fresh air to displace exhaust fumes and keep carbon-monoxide percentage in the tunnel air well within a safe concentration. Sensitive recording instruments in the main control room give a continuous picture of carbon-monoxide content, detecting and registering the increase from tunnel entrance to exit. Upper limit is 4 parts of CO in 10,000 parts of tunnel air although normal operation maintains concentration at about 2 parts in 10,000.

This system requires not only air supply and discharge equipment to carry normal load but enough reserve capacity to take care of breakdowns and the extra load from infrequent vehicle fires. Ventilation is by transverse distribution to produce an air change every 1½ minutes. Normal ventilation requires 3,760,000 cfm of fresh air.

Handling equipment consists of 42 blowers and 42 exhaust fans, from 85,000 to 230,000 cfm capacity. Fans are driven by variable-speed motors, from 25 to 185 hp each, with total installed capacity of 6000 hp. Power supply consists of three 13,200-v feeders from the New York side, as well as three from the Jersey side. Each feeder comes from a different point on the utility system to minimize danger of complete power interruption. Air-cooled transformers, 13,000/2300/440 v, feed the power-distribution system.

An elaborate system of signals, alarms, lighting and drainage keeps traffic moving swiftly and efficiently. Nerve center is the supervisory room in the New York administration building. Through remote control one man operates the entire ventilating system. He communicates by telephone with patrolmen along the tunnel walkway. Over an alarm system each patrolman can signal this operator of a traffic tieup or fire that requires emergency trucks stationed at each tunnel mouth. If supervisory control fails, attendants at unit control stations in each fan house operate ventilating equipment.

EARLY ACHIEVEMENTS

Born and raised in Elizabeth, N. J., Joe received his early education at St. Patrick's Parochial School. He acquired advanced education in power engineering through night school, home study and correspondence courses.

Starting as a wiper in Du Pont's Haskell power plant, he furthered his knowledge of steam, electric and hydraulic pumping equipment, refrigeration, boiler operation and maintenance. From 1913 to 1926 his positions ranged from switchboard operator with Public Service Corp of N. J. to chief engineer with Bethlehem Steel Co at Elizabeth. In 1927 he was appointed to the operating staff of Holland Tunnel, where he was later promoted to the position he now holds.

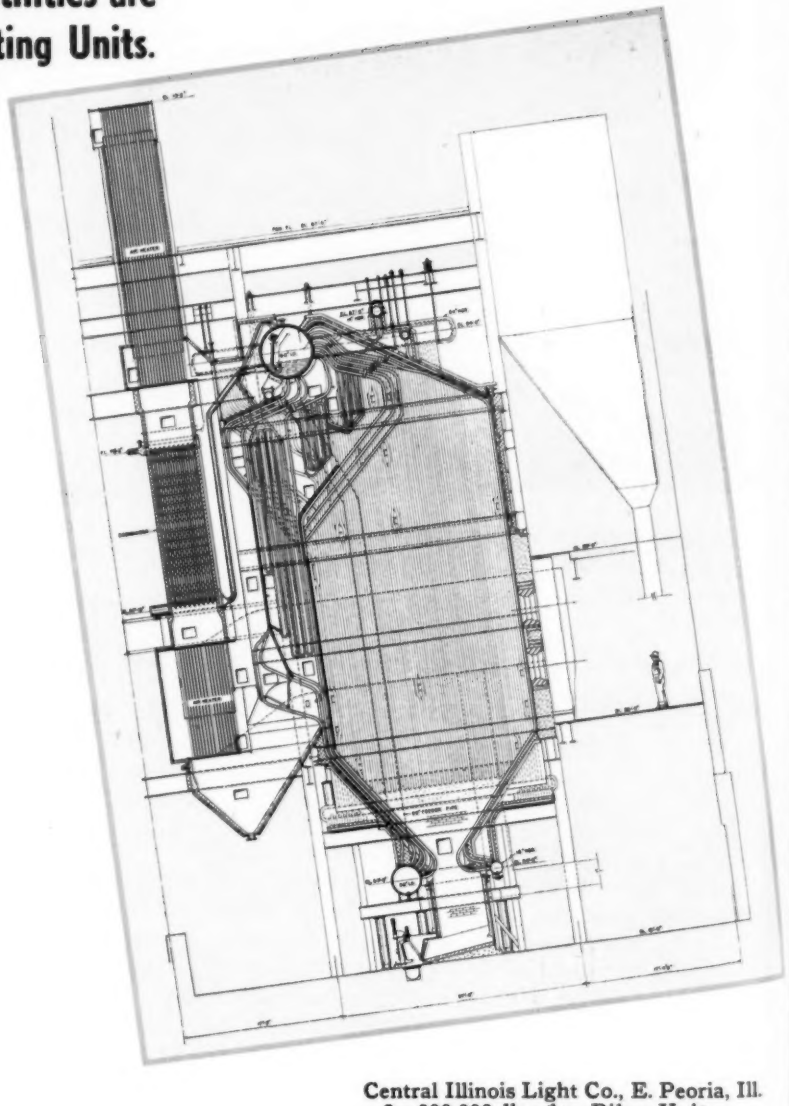
Joe has been active in NAPE affairs since 1917 when he joined Elizabeth Chapter 14 and became chairman of the educational committee. In 1920 he was elected chapter president. The next year, as state educational chairman, he advocated and supervised the adoption of power-plant engineering courses in night and vocational schools in Elizabeth and Newark. He was elected state president in 1925, and later was drafted as state secretary to carry on his good work.

In the National Association, Flynn started his career in 1919 as a delegate. Through succeeding years to 1927, he attended all conventions as a delegate. In 1923 and '24 he was elected national trustee of the life and accident division, and became chairman of the group. Later, elected national conductor, and then appointed as special U. S. deputy and national trustee, Joe continued to round out his NAPE work until 1946 when he was elected national vice-president.

Besides his engineering activities, Flynn is a director of Homeland Building and Loan Association, of Elizabeth, and is chairman of the advancement committee of the Eastern division, Union Council, Boy Scouts of America.

The Public Utilities are SWINGING to

During the past year well over sixty per cent of all Riley Sales were to public utility plants. This is definite proof that the public utilities are also swinging to Riley Steam Generating Units.



Central Illinois Light Co., E. Peoria, Ill.
2—300,000 lbs./hr. Riley Units
925 lbs. pressure
900°F. steam temperature

The following public utilities have recently ordered Riley Steam Generating Units

Utah Power & Light Co., Provo, Utah
1—450,000 lbs./hr.
Arkansas Power & Light Co., Cecil Lynch Plant
1—650,000 lbs./hr.
Houston Lighting & Power Co., Greens Bayou Sta.
2—675,000 lbs./hr.
Houston Lighting & Power Co., West Junction Sta.
1—675,000 lbs./hr.
City of Los Angeles, Calif., Harbor Steam Plant
3—825,000 lbs./hr.
Potomac Edison Co., Riverton, Va.
1—350,000 lbs./hr.
Public Service Co. of Ind., Dresser Station
1—300,000 lbs./hr.
Public Service Co. of Ind., Edwardsport, Ind.
2—400,000 lbs./hr.
Public Service Co. of Ind., Noblesville, Ind.
3—300,000 lbs./hr.
Mississippi Power Co., Hattiesburg, Miss.
3—230,000 lbs./hr.
Union Electric Co. of Mo., St. Louis, Mo.
3—310,000 lbs./hr.
Ohio Edison Co., Mad River Station
1—250,000 lbs./hr.
New Orleans Public Service Co., Market St.
1—330,000 lbs./hr.
Gulf Power Co., Pensacola, Fla.
2—230,000 lbs./hr.
Iowa-Illinois Gas & Electric Co., Davenport, Iowa
2—250,000 lbs./hr.
Central Illinois Light Co., Peoria, Ill.
1—300,000 lbs./hr.
Southwestern Public Service Co., Borger, Texas
1—330,000 lbs./hr.
S. Carolina Power Co., Charleston, S. C.
1—230,000 lbs./hr.

In addition to the above two units, Central Illinois Light Company has installed two additional units at Peoria and has just ordered a unit for Springfield.

TRADE MARK Rx REGISTERED

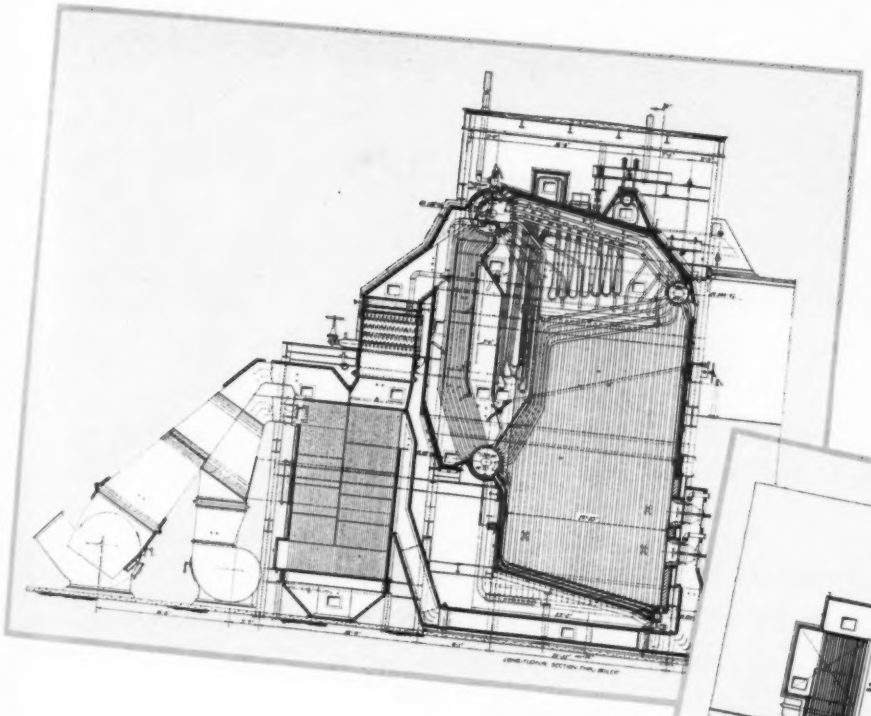
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati St. Paul Pittsburgh Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

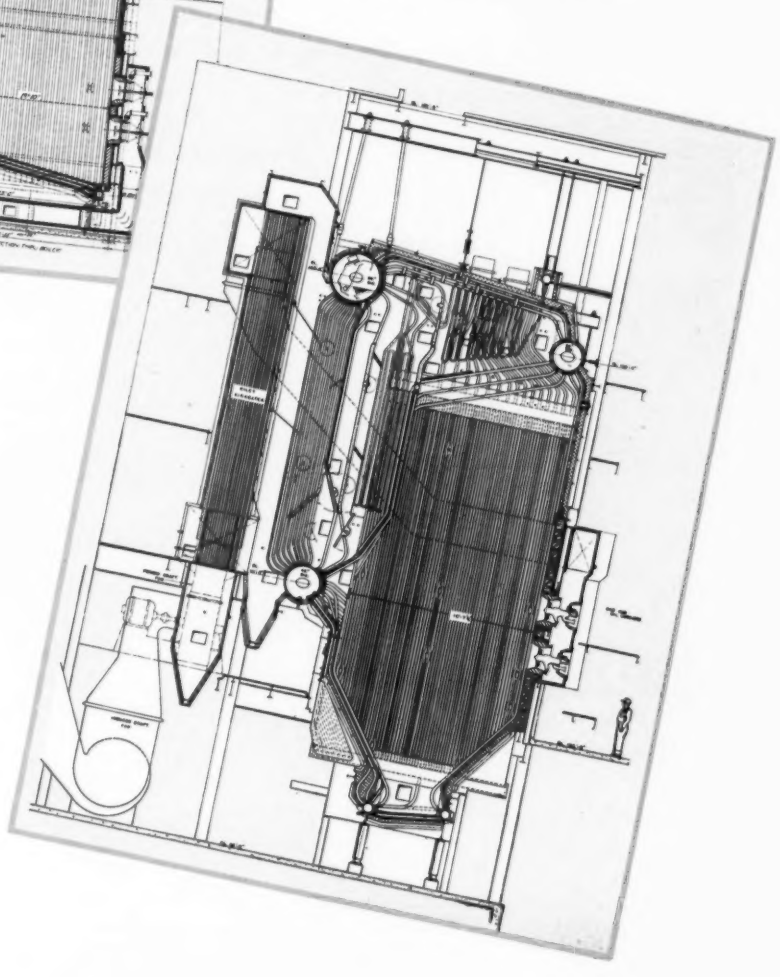
BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Riley Steam Generating Units



Houston Lighting and Power Company has ordered seven Riley Units having a capacity of 3,195,000 pounds of steam per hour. The last three units ordered have a capacity of 675,000 lbs./hr. each.

Houston Lighting and Power Co.
West Junction Station
Houston, Texas
400,000 lbs./hr.
1000 lbs. pressure
905°F. steam temperature



Mississippi Power Company, a Commonwealth and Southern Corporation property, has ordered three Riley Units. Commonwealth and Southern Corporation has also ordered two duplicate units for Gulf Power Company and one unit for South Carolina Power Co.

Mississippi Power Company
Plant Eaton
Hattiesburg, Miss.
230,000 lbs./hr.
975 lbs. presure
905°F. steam temperature

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

Between meetings delegates gather in the Public Garden at statue of George Washington for the official photograph

Power Engineers Convene in Boston

Newly elected vice-president Clifton R Harding, Lowell, Mass. Chapter 17

Delegates from regional NAPE chapters streamline business meetings to provide more time to attend the engineering sessions and the National Power Show. New officers are elected

▶ National Association of Power Engineers held its 64th annual convention and National Power Show at the Statler Hotel, Boston, August 25 to 29. Attending were about 206 delegates, over 2000 visitors and 330 manufacturers' representatives.

First session, called to order by Thomas A Ray, past president, New England States Association of Power Engineers, featured addresses by John B Hynes, mayor of Boston; George E Wills, national president of NAPE; Michael T Kelleher, president of Boston Chamber of Commerce; Joseph P Flynn, national vice-president. In addition to the usual association reports, there was a well-rounded program of educational movies and lectures:

Moving Pictures. The movies shown were: "Hack Saws and How to Use Them" and "Machine Knives in Industry," by Simonds Saw & Steel Co; "Selectomatic," a story of elevator controls by Westinghouse Electric Corp; "WaterFOG—Master of Fire," by Rockwood Sprinkler Co; "The Inside Story," by Socony Vacuum Oil Co.

Lectures. Papers presented were: "The Research Program of the American Society of Heating & Ventilating Engineers as It Applies to Power Engineers," by Cyril Tasker, director of research, ASH&VE; "The Coal-Burning Gas Turbine for Locomotive Service," by John I Yellott, director of research, Locomotive Development Committee, Bituminous Coal Research Inc; "What the Design Engineer Thinks About," by W P Saunier, design engineer, Jackson & Moreland; "Maintenance of 85% Magnesia Insulation," by U W Smith, general manager, Magnesia Insulation Manufacturers' Association; "Safety Features of the Mystic Station," Boston Edison Co, by W A Coolidge, safety engineer.

Exhibits. The National Power Show, held in conjunction with the convention, was without question the best in many years. Representatives from 77 companies, on hand to explain the use of their products, were kept busy because the show was crowded from the time the doors opened until they closed at night.

Daily News Sheet. Reviving a practice instituted by Power many years ago, the *National Engineer* published a daily news sheet, which they called the *Boston Convention Daily*, to record the delegates' comings and goings, both official and unofficial. The editors uncovered a few skeletons that could stand a little harmless rattling and kept everyone informed as business meetings divulged their secrets. Sad part was that the *Daily* could not be delivered to individual rooms, according to Statler Hotel service, and delegates had to appear in public before discovering whether they were on the receiving end of a joke that day.

Election of Officers. At the final business session Joseph P Flynn, Elizabeth, N. J. Chapter 14 (see page 95) was elected president for the year 1947-48. Elected as vice-president for the same term was Clifton R Harding, master mechanic, power plant, Portsmouth Naval Ship Yard, Portsmouth, N. H., and member of Lowell, Mass. Chapter 17. Mr Harding is a past president of Lowell Chapter, and New England States Association, NAPE. He was a national trustee for four years, and is a member of the board of directors. Officers reelected for another year are: secretary, A F Thompson, Chicago, Ill.; treasurer, Harry J Harp, Philadelphia, Pa. Next year's convention will be held on August 23, 1948, in St. Paul, Minnesota.

Keep Cooling Systems Clean

If scale, slime or silt adheres to transfer surfaces heat flow is choked and machine output lowered. Here are remedies to fit each kind of trouble and put your equipment in good shape

By B F HEYE, *Central Power & Light Co*

▶ TO INCREASE YOUR PROFITS, maintain a clean cooling system. Not only does it reduce other forms of maintenance and the amount of power required, but it also increases plant capacity. In comparison to the savings effected, chemical cost and time consumed in daily treatment are low.

Keeping a cooling system clean involves the control of only two items:

1. Suspended matter.
2. Bicarbonates of calcium and magnesium.

Suspended matter consists of silt, slimes, bacteria and organic growths. Water added to a cooling system should be as free of silt as possible. From time to time the system should be flushed of small accumulations.

Sterilization. Slimes, bacteria and organic growths are easily controlled. Chemicals most widely used for this purpose are sodium pentachlorphenate, copper salts, chlorine, chloramines and potassium permanganate.

Sodium pentachlorphenate is the sodium salt of a chlorinated phenol and is stable in alkaline waters. Good control can be had with 20 to 30 ppm.

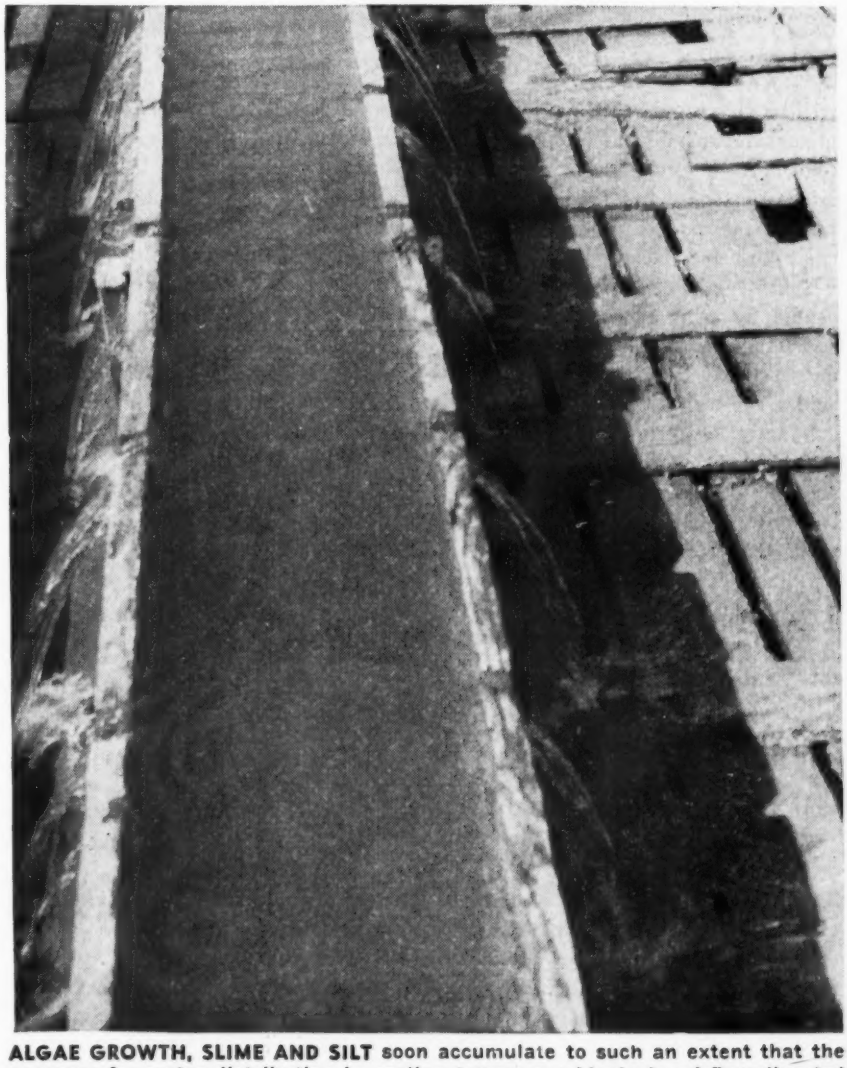
Copper sulphate is the commonest copper salt used for slime, bacteria and organic-growth control. The dosage required varies from 0.05 to 10.0 ppm, depending on the type of organism in the cooling system. The safe (limiting) dosage for fish varies from 0.14 to 2.0 ppm. Copper salts are very corrosive to iron and steel, and are ineffective in alkaline waters because they precipitate as copper hydroxide.

Chlorine is highly toxic to bacteria, algae and slimes. Because chlorine acts on dead and dormant oxidizing matter, as well as upon living organisms, a certain amount known as *chlorine demand* must be supplied before a residual available as an algaecide or bactericide, can be maintained. A residual of 0.5 ppm assures destruction of most microorganisms.

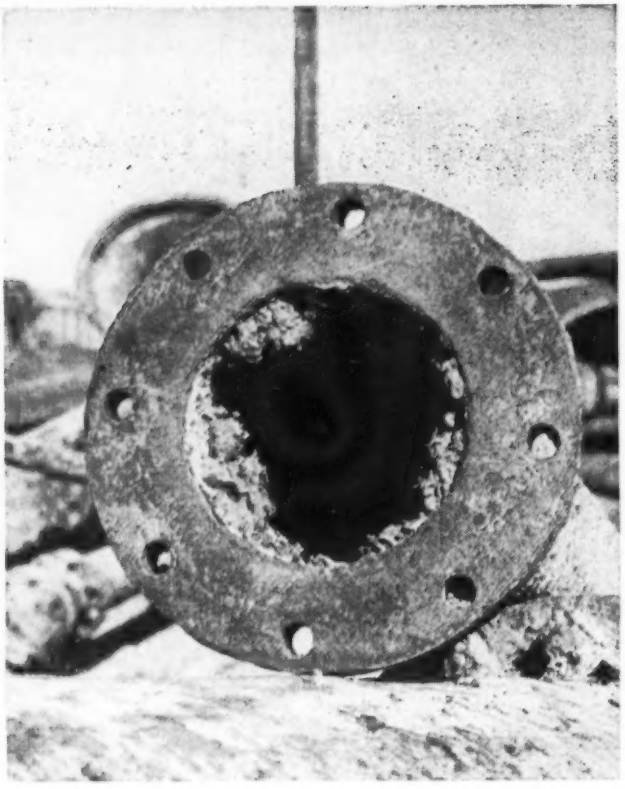
Chlorine may be administered as calcium hypochlorite, or as gas from a cylinder of the liquid.

Frequency of chlorination depends upon water temperature, season of the year, amount of wind, location of the cooling system, and other factors. Some systems require only a few minutes treatment per week. Usually three one-hour applications a week, holding a residual of 0.5 ppm, maintains a cooling system in excellent condition. Some operators find it more profitable to chlorinate for several hours at a time with chlorine residual content of 1.0 ppm to get a kill, and then to cease chlorination until slimes, or organic growths, appear. My preference is for short chlorinating periods daily, because slime growths on heating surfaces are often difficult to find unless the system is shut down. These interfere materially with heat transfer.

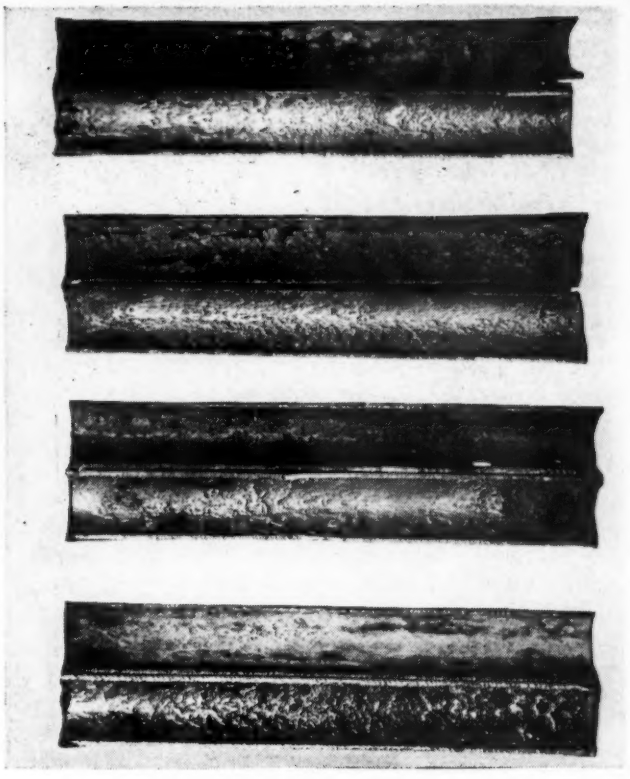
Chloramines are obtained when chlorine and ammonia are fed in correct proportions. Depending upon the water pH, monchloramine, dichloramine or



ALGAE GROWTH, SLIME AND SILT soon accumulate to such an extent that the passages for water distribution in cooling towers are blocked and flow diverted



IRON BACTERIA form flocculent masses that build up on the cooling surfaces to interfere with heat transfer



CORROSIVE ATTACK on brass tubes after six months' service with sea water. Samples from Corpus Christi, Tex.

trichloramine are formed. The chloramines are unstable in high concentration, but are very reactive and toxic to microorganisms in small concentrations. Chloramines are rarely used in cooling-water systems.

Scale Prevention. Scale can be prevented by using zeolite-treated waters, sodium hexametaphosphate, inorganic and organic colloids, and sulphuric acid.

Sodium hexametaphosphate and the colloids hold carbonates and bicarbonates in solution at high concentrations, so long as the temperature remains under 120 F. The sodium hexametaphosphate concentration usually carried is from 3 to 5 ppm.

Tetraphosphoglucosate, a mildly acid phosphate colloid, forms suspensoids with heavy metals, prevents precipitation, and stabilizes supersaturated solutions. It is a film-type corrosion inhibitor.

Bicarbonates. Control of calcium and magnesium carbonate with sulphuric acid is economical. The acid is added in such amounts that the carbonates and bicarbonates are reduced in quantity to their solubility factor at operating temperatures, namely 20 to 30 ppm. The water still remains alkaline.

The acid that is added is neutralized by the alkaline carbonates and, likewise, these carbonates have been changed to highly soluble calcium and magnesium sulphate with the liberation of free carbon dioxide. The latter lowers the water's pH value temporarily but aeration soon liberates the gas.

If a system is slightly scaled good practice reduces the carbonate content to 10 ppm until it is clean, and then maintains it at 20 to 30 ppm. A system can be kept clean by holding the carbonates at this figure *daily*.

Removing Scale. On a badly scaled system hold the water slightly acid (200 ppm) from one to several days—depending on how much scale is present. As soon as the scale is removed, maintain 20 to 30 ppm carbonate content. Run on the acid side no longer than necessary because after scale is removed the acid attacks the metal.

Adding 40 to 60 ppm of organic chromates, or 100 ppm of inorganic, gives metal protection with pH values as low as 5.8, which is considerably on the acid side. In acidulating waters for scale removal, a 1% solution of sulphuric acid gives good results in a short time.

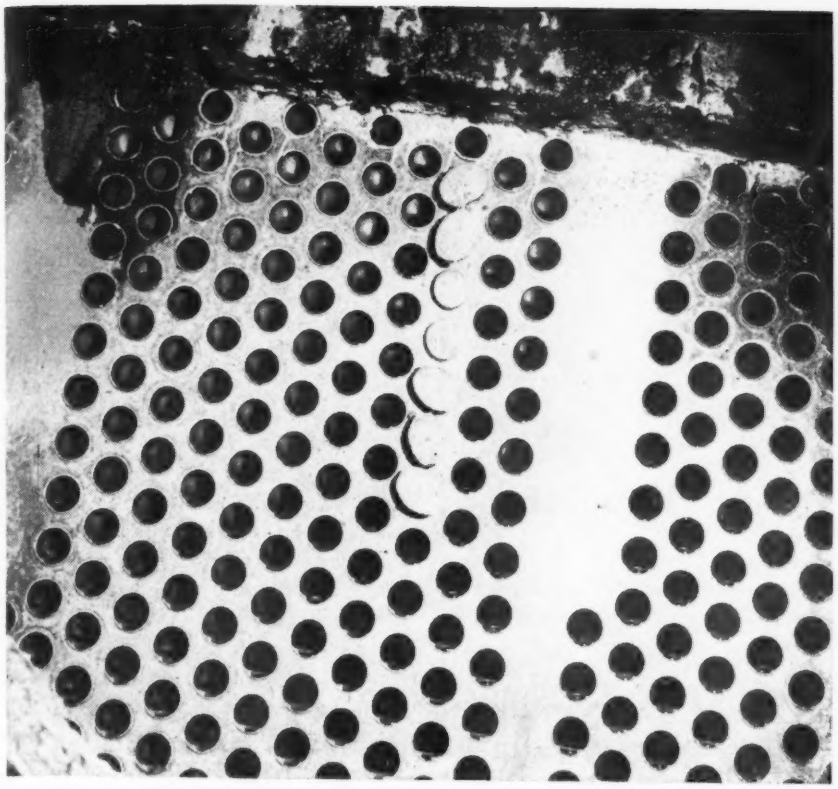
While maintaining a 20 to 30 ppm alkalinity in the cooling water prevents scale, as well as slowly dissolving existing deposits, corrosion of the metal must be considered. Some waters have a pH value below 7.0 even though the alkalinity is 20 to 30 ppm.

Never treat cooling-system water in such a way that a pH value below 7.0 is maintained for any considerable time, regardless of the alkalinity. Results are excellent if the alkalinity is reduced to a point where the water has a pH value of 7.3 after the free carbon dioxide is liberated by adding sulphuric acid. If desired, this treatment can be regulated entirely by observing and maintaining the water at a pH value of 7.3. Even though the treatment is controlled by alkalinity titration, the value at which the alkalinity is maintained must correspond to a pH value of 7.3.

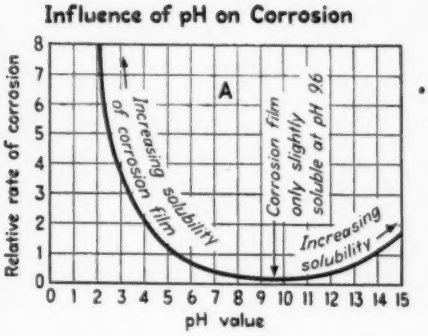
One quart of sulphuric acid reduces alkalinity by 468,175 ppm. The necessary quantity, in quarts, can be estimated by multiplying the water capacity by the desired reduction in alkalinity and dividing this figure by 468,175.

Despite the fact that some operators question the advisability of acid control, a number of plants have used this form of treatment for years with good results, and with no more corrosion than is ordinarily encountered in concentrated mineral solutions.

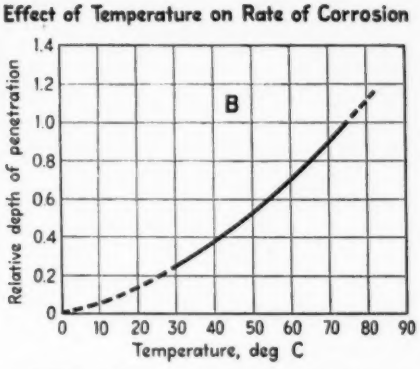
Photo on facing page shows tube con-



AFTER 16 YEARS of sulphuric-acid treatment these brass tubes, rolled in Muntz-metal tube sheets, and cast-iron water box show neither corrosion nor scale



IN WATER at pH of 9.6, a minimum amount of metal goes into solution



TEMPERATURE influences the rate at which metals are dissolved in water

dition in steam surface condenser after 16 years of this type treatment without adding any inhibitors. Mineral concentration has been maintained as suggested previously. No evidence of scale deposits, or corrosion of the tubes or cast-iron water box is apparent.

Regardless of what process is used for minimizing scale the use of chromates for corrosion control is highly recommended, because air saturation and concentrated minerals make a strong corrosive media.

Natural waters, which become highly concentrated with minerals, as in cooling systems, are extremely corrosive, and a small percent of the water should be continually discharged to waste.

RECOMMENDED PRACTICES

1. How to maintain clean systems:

Keep alkalinity of the cooling water at 20 to 30 ppm or pH of 7.3, or both.

2. How to clean up systems that are slightly scaled:

Keep alkalinity of the cooling water at 10 ppm until system is clean and then operate at 20 to 30 ppm alkalinity, or pH of 7.3, or both.

3. How to clean up systems that are badly scaled:

Operate with slightly acid water one to several days, depending on how much scale is present, then about ten days at 10 ppm alkalinity. Continue to operate with the water at 20 to 30 ppm alkalinity, or pH of 7.3, or both. Do not operate on the acid side longer than absolutely necessary. Use organic chromates with the acid treatment if possible.

A simple way to determine whether water is on the acid side is to add six drops of methyl orange to a sample (about 50 cc). If resultant color is light to reddish pink, the water is acid. If the color is orange, it is neutral, and if yellow, it is alkaline.

4. Sterilize the cooling water daily with chlorine, being careful to maintain 0.5 ppm residual for one-half hour. At times it may be possible to reduce this frequency of treatment to twice or possibly once a week.

APPLYING CHEMICALS

1. Chlorination.

A. Using calcium hypochlorite.

This material is sold under various trade names, such as H T H, Pittchlor Perchloron, etc. It usually comes in 3¾ and 5-lb cans, and 100-lb drums, and yields 70% available chlorine. In applying calcium hypochlorite add enough to obtain a residual chlorine content of 0.5 ppm. Add it to the water in such a way that it mixes thoroughly before the circulating pump picks it up. Often the granules can be sprinkled through the cooling basin.

B. Using liquid chlorine.

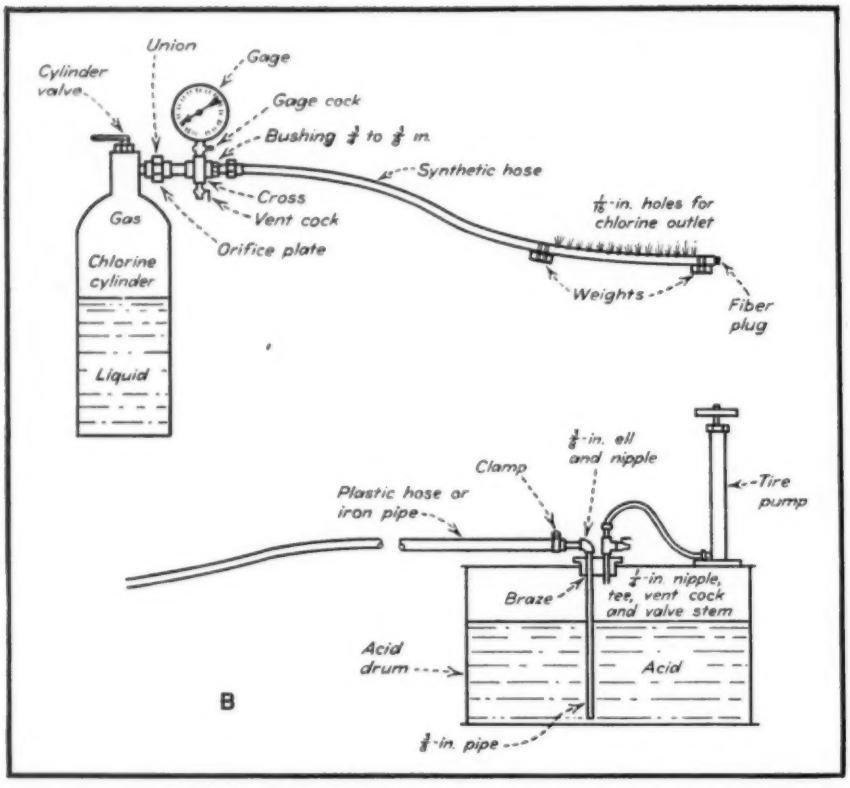
Chlorine can be purchased as a liquid in containers of 50, 100, 150 and 2000 lb. Its pressure corresponds to the temperature. At about 80 F, the pressure is 80 psi. If discharge is from the top, chlorine gas is obtained; if from the bottom, liquid is obtained. The gas is always used for treating cooling water.

As chlorine is drawn off, the liquid temperature falls; if liberated too freely, the liquid freezes.

Apply chlorine as follows:

Insert a fiber washer with a 3/32-in. orifice in the coupling half of a ¾-in. pipe union and attach to the cylinder outlet. Screw a short nipple into the union, and attach a cross fitting so two of its remaining outlets stand vertically. On the top outlet, screw a 0- to 30-psi pressure gage with a stopcock. On the bottom outlet, screw in a petcock, whose purpose is to release the pressure after chlorinating, and break the vacuum formed on cooling, to prevent water being drawn up into the tubing. Be sure petcock is closed during chlorination, and open the rest of the time.

To the other outlet screw a nipple and attach synthetic hose or pipe long enough to reach inside tower basin.



INTRODUCING CHLORINE can sterilize the water in a cooling system, as at A. Acid can be fed to cooling-tower basin directly from a shipping container, at B.

Starting 6 in. from the basin end drill 1/16 in. holes 6 in. apart through one side wall of the hose for a suitable distance. Blow air through the hose to remove loose material. Now stop up the open end securely with a fiber or wood plug. Attach sufficient weight to keep this length of the hose submerged during chlorination, and stretch it out in the basin to obtain best mixture of chlorine gas and water. Do not allow free chlorine to escape at water surface.

After the apparatus is fabricated, and all joints made up tight, close the petcock on the bottom of the cross, and open the cylinder valve just enough to feed chlorine as fast as it can be absorbed. Eight minutes later, check for residual chlorine with a comparator. Adjust the feed until a residual of 0.5 ppm is obtained. Continue chlorination for 15 to 30 min. Frequency of application depends on the amount of slime, algae and other organic growths present. After chlorination, close the tank-valve and open the petcock (or valve) on bottom of cross.

2. Acid Treatment.

A technical grade, 66 deg Baume, sulphuric acid can be purchased in 4200-gal tank cars and 50-gal drums. Weight is 15.3 lb per gal.

If a drum is bought, lay it down in a cool place with the bung up. Loosen the bung cap for a breathing action. Application is usually effected by adding the acid to the cooling-tower basin in such a manner that water and acid mix thoroughly before the liquid reaches the circulating pump.

Remove the bung cap and drill two holes in it, which ⅜-in. pipe will just pass through. In one hole braze a short ¼-in. nipple so it is just flush with the inside of the bung. To the nipple outlet screw a ¼-in. T in which an ordinary automobile-tire valve stem has been brazed. Into the side T-outlet screw a petcock.

Now secure a piece of ⅜-in. pipe, threaded on one end and long enough to reach within 1 in. of bottom of barrel (lying on its side with bung up) with the threaded end sticking out far enough to attach a connection. Braze the pipe to the bung cap in this position. Screw an L on the threaded end of the pipe and a short nipple into the other end of the L.

Clamp on a synthetic hose that is long enough to reach into the pond, where good mixing will occur. Anchor the discharge end above the level of the barrel so the acid will not siphon from it. Move the barrel as near the point of application as possible and mount it at about the same level as the cooling-tower basin.

With a tire pump connected to the valve stem, force a little acid from the drum with a slight air pressure. After waiting a short time for the acid to mix with the water throughout the circulating system, make a titration check to determine whether enough has been applied. If more is required, duplicate the procedure. When sufficient acid is added, remove tire pump, release air pressure in drum by opening petcock.

[EDITOR'S NOTE: Emptying barrels with air pressure is dangerous because there is no way of determining how much pressure the container will safely withstand. Be extremely careful.]

SAFETY MEASURES FOR COOLING SYSTEM WORKERS

1. When working on chlorine and acid drums, stand on the windward side.

2. If sulphuric acid gets on your skin or in your eyes, flush with large quantities of fresh, clean water. (If clean water is not available, use any kind.) Do not apply alkali directly to acid on your skin. Should a burn result because you neglected to wash off the acid, flush the burned portion with lots of clean water and apply a good burn ointment. Use castor oil for eye burns. Then see a physician.

3. Protect your eyes with goggles.

4. Use caution in breathing even small amounts of chlorine gas because it irritates the nasal passages, bronchial tubes, lungs and throat. It produces the same symptoms as a bad cold or pneumonia. A hacking cough can be relieved with a cough syrup rich in oil of peppermint. Use a chlorine gas mask if the gas is very strong or you are working in confined quarters.

A person who has inhaled large quantities of chlorine gas has a constant hacking cough, increased breathing rate, increased pulse action, and eye sight that is blurred and milky. Consult a physician.

THE OPERATING ENGINEER

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS—ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Smoke Abatement Can Pay Off

Loss of boiler capacity plus smoke troubles made this operating engineer introduce furnace and combustion control changes to carry process and heating with less fuel and a smoke-free stack

▶ STEAM HEATING AND PROCESS NEEDS for tenants of O B Potter Properties, Inc, New York City, place heavy scheduling and operating problems on the Astor Place plant, and on J W Brown, chief engineer. This is a central property whose boiler room supplies steam to the company's four loft buildings. Added to "normal" difficulties are the immediate ones of (1) preparing available boiler capacity for optimum performance when the winter heating load arrives and (2) reshuffling the boiler room to fit a smaller space.

Four 100-psi steam generators, two 7500-lb-per hr dry-back scotch-marine units and two 6250-lb-per-hr hrt's originally supplied the steam load. For years the boiler and pump room occupied a vault under the sidewalk from the building line to the curbstone.

But a loss in this operating space resulted when the City of New York approved an extension of the Astor Place station of the Interboro Rapid Transit subway, which was to reach into the Potter Properties boiler room. Among the major changes that were made, steps had to be taken to insure optimum performance from the boilers still available on the line.

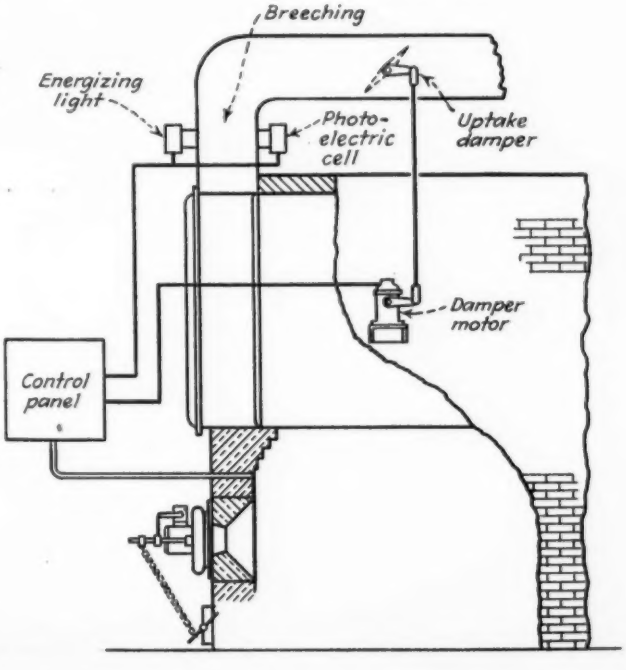
Steam load is for four loft buildings, where the tenants' needs are supplied through headers at 100 psi. Meters at the takeoff points permit accurate billing for users' steam consumption.

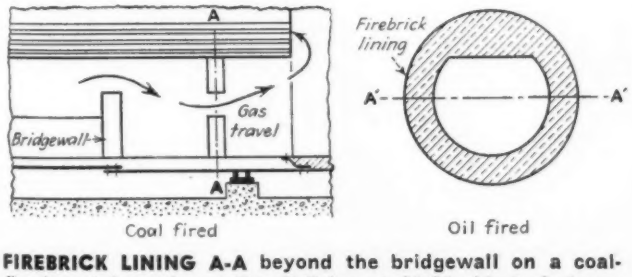
Condensate returns through traps by gravity feed to a return tank in the boiler room. The plant operating engineer reviews the process services to which the tenants put the steam. Where these processes pollute the steam he refuses to accept condensate and directs this waste to the sewer.

Makeup consists of city water admitted to the boiler cycle at the return tank. From this point some combination of four cross-connected, reciprocating pumps delivers water through a closed feedwater heater to the boilers. A flow meter installed in the feed line records the water supplied for evaporation.

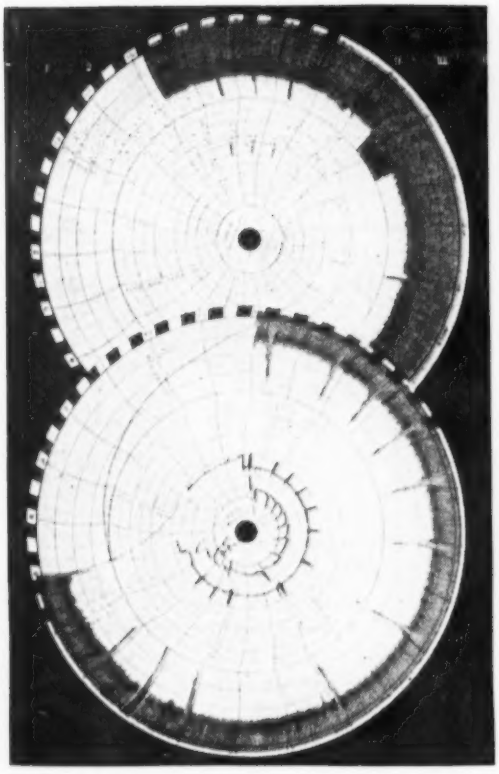
The four reciprocating pumps are cross-connected to permit use of units singly or in combination for feedwater pumping and other services not connected with the steam cycle. For instance, they pump out the blowdown tank and dump its contents into the sewer. Blowdown runs somewhere around 5% with the usual operating procedure involving a blowdown of a gage and a half once a day. All boil-

A PHOTO CELL is struck by a light across the breeching. Any smoke reduces the light strength

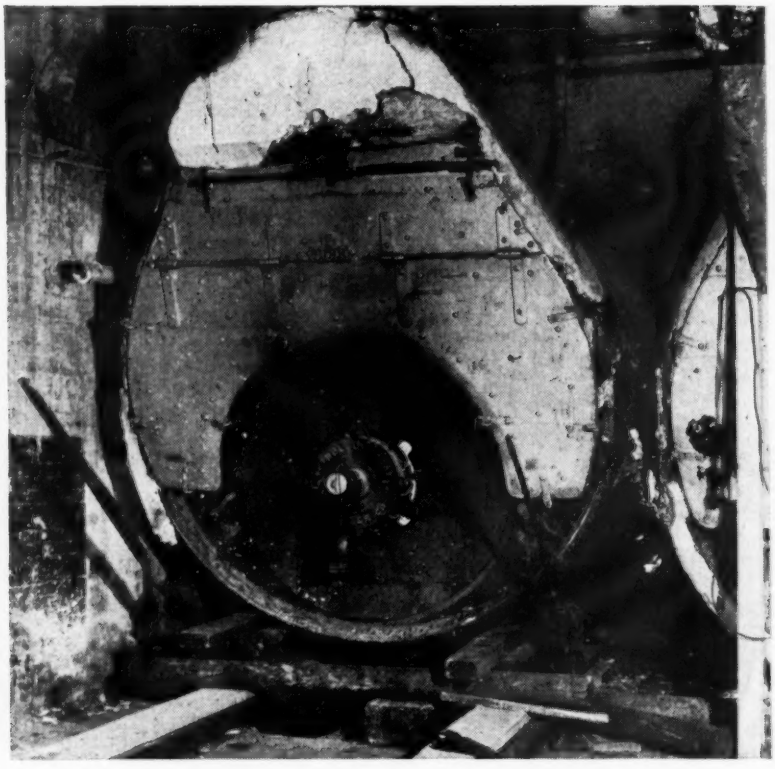




FIREBRICK LINING A-A beyond the bridgewall on a coal-fired scotch-marine unit; oil firing at A^1-A^1 aids turbulence



CO_2 RECORDING CHARTS show 5% before the photo-cell control; 13% after



READY TO MOVE. One 7500-lb-per-hr scotch marine boiler, which had to be moved for a subway-extension program, stands ready with the piping dismantled

ers have a chemical control of scale-forming solids in the water.

Combustion Process. For firing, oil is pumped at 35 psi through an oil preheater. Here it reaches a temperature of 170 F before entering the automatic high-low rotary-cup burner. Chemical additives help keep sludge from settling out in the fuel lines and tank.

Flue gas moves through the boilers under natural draft. Breeching of the two scotch-marine units crosses over a boiler-room walk, then drops down under the elevator pit, and finally enters the stack. Much of the solids entrained in the flue gas of the scotch-marine boilers is thrown out as the gas travels this path. Clean-out doors in the breeching permit removal of all collected solids. The hrt has its breeching connected to a separate stack.

It is in the combustion process that economies have been effected that (1) increase the combustion rate to allow higher steaming (2) decrease the smoke issuing from the stacks while saving fuel.

Increased Combustion. Back in the period when the steaming units were coal fired chief engineer Brown found he could increase the steaming rate by a change in furnace design. This change improved combustion by introducing added turbulence beyond the bridgewall in the path of the gas.

This addition came about by building a firebrick lining, diagram on p 103, within the furnace chamber beyond the bridgewall. The lining narrowed down the flue-gas exit path and produced a more intimate mixture, plus a certain amount of change in direction for flue gas.

The same idea was incorporated in the furnaces when a change from coal-firing to oil was made. The bridgewall was removed so that the only turbulence-producing element lying in the path of the furnace gas proved to be the narrow firebrick-lined wall.

Preventing Smoke. This mechanical aid to better combustion did not clear up a smoke problem that frequently developed. The only controls available were barometric dampers and manual adjustment of fuel and furnace draft.

The only solution to smoke-free operation under this arrangement was to supply the furnaces enough excess air to avoid smoking. Flue gas under this setup gave a reading of about 5% as shown by portable CO_2 recording charts, above. Fuel-oil consumption reached an annual figure of 250,000 gallons.

Then the plant went to photoelectric combustion control, in which the photo cell, diagram on p 103, serves as the heart of the mechanism. A light, played from one side across the breeching strikes a photo cell on the opposite side. The density, or more properly the smoke content, of the flue gas passing up the breeching affects the strength of the light beam reaching the cell.

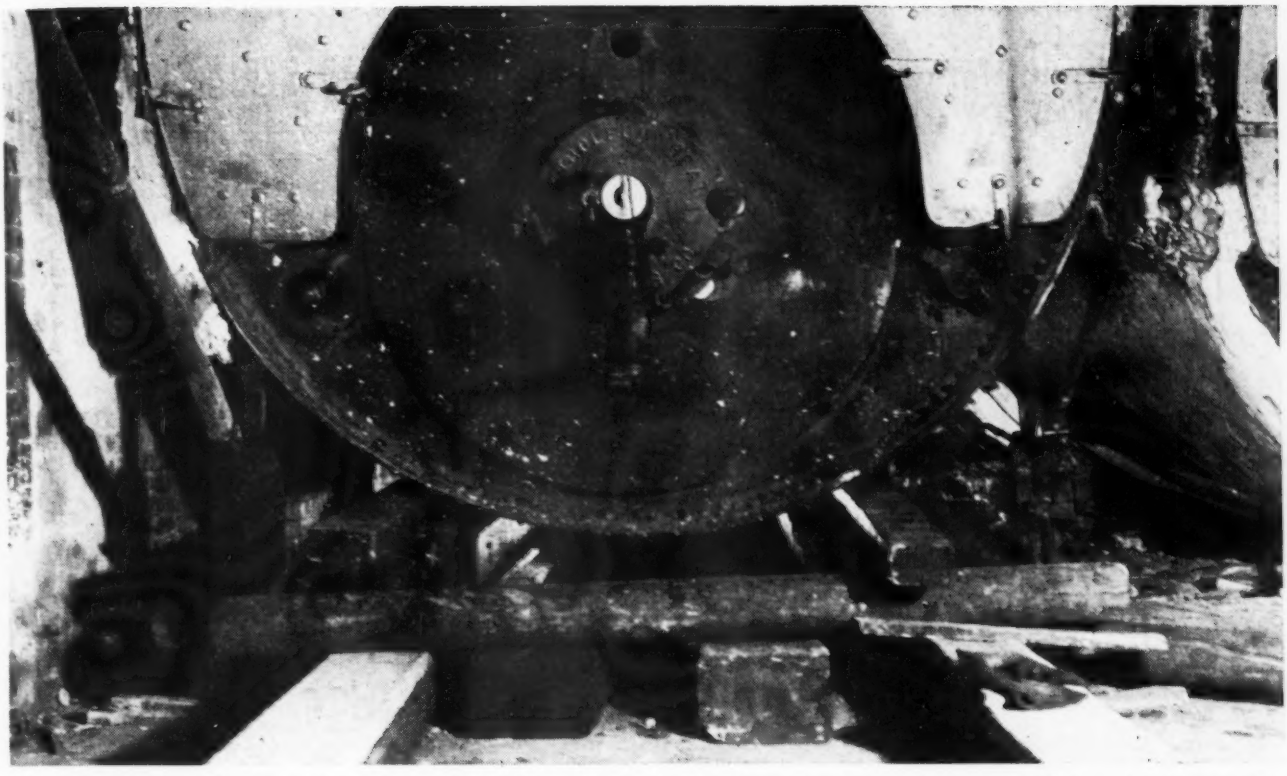
Strength of the light beam can be measured relatively. At the point of optimum CO_2 (about 13%) its strength serves as the zero or midpoint of a gage mounted on a boiler-room panel.

This panel houses (1) smoke-reading meter (2) synchronous motor-operated device that plays the light across the breeching onto the photo cell once every

CORRECTION

An error of interpretation appeared in the data sheet, p 134, Aug 1947. Vertical axis should be labeled, "Elongation, in." Example should read: "A 1.5-in. stud measures 16.514 in. unloaded, and 16.529 loaded. Distance between facing nut surfaces is 12.0 in. Find tension in the stud.
Tension length = 13.5 in.
Elongation = 16.529 − 16.514 = 0.015 in."

Find these values on chart scales, follow traces to their intersection and read 33,300 psi.



ON ITS WAY. The boiler unit, side by side with another similar boiler (right), over jacks shown on both sides of boiler drum, has been raised up on skids and rollers for its trip to its new location in the plant, which is shown below

eight seconds (3) necessary circuit-closing mechanism to operate a reversible compensating motor attached to the damper in the boiler uptake.

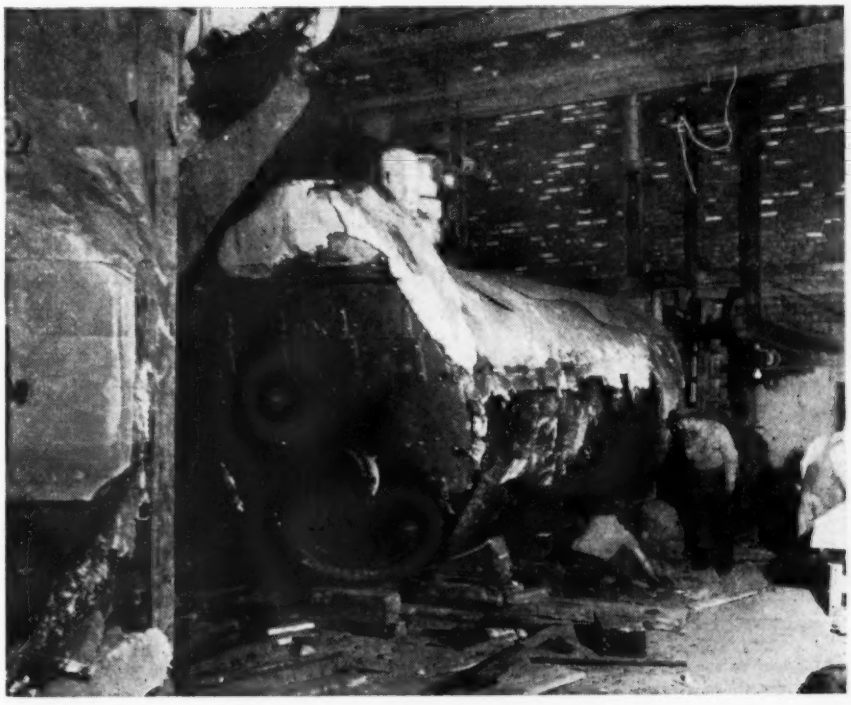
This damper control relies upon a spring-loaded system which, when unbalanced, closes the circuit that energizes the damper motor. The motor, in turn, moves the uptake damper to balance the spring-loaded furnace-draft control.

Fuel Savings. Over and beyond removal of the smoke problem the combustion control produced a saving in fuel consumed. The Astor Place plant reduced its normal 250,000 gallons of fuel oil annually by 14%. The CO_2 content in the flue gas stays at 12 to 13% as in recording chart on facing page. Need for boiler supervision has been eased considerably and boiler-room personnel give more time to other plant duties.

MOVING THE BOILERS

The subway construction program forced major reshuffling in the boiler room. One of the hrt boilers just simply had to go for lack of space. The scotch-marine units, which were operated side by side, photo on facing page, had to be changed. One was relocated.

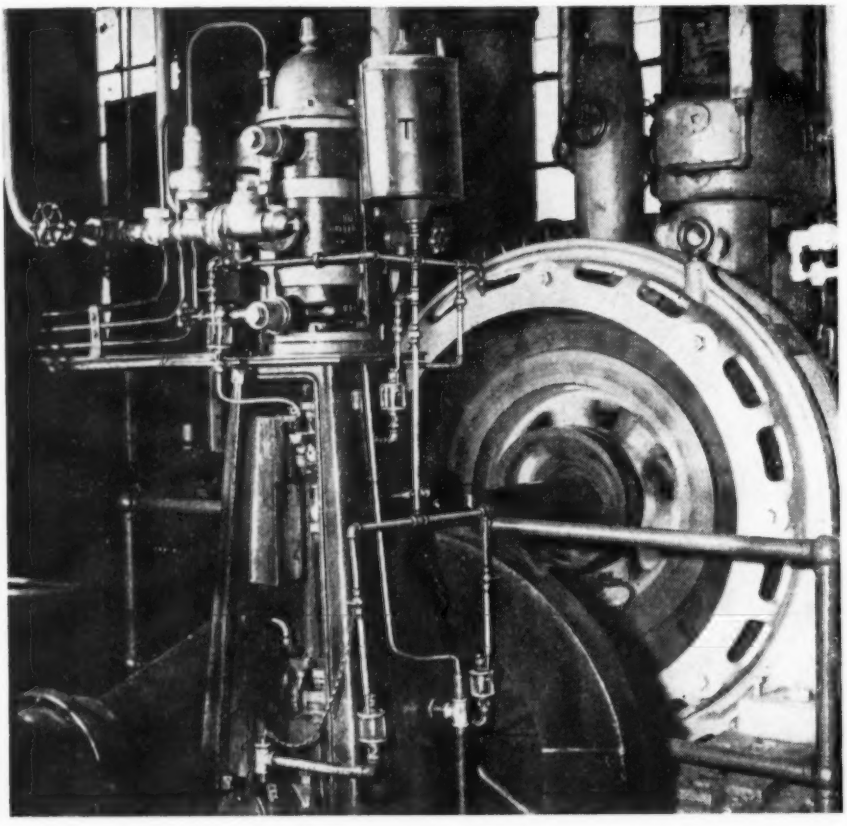
To accomplish this the boiler was taken out of service and piping and other connections dismantled. Next the unit was jacked up on skids, and rolled to a new location, as the three photos show. In its new spot the unit now faces the other scotch-marine boiler and both employ the same breeching to connect to the chimney.



SETTLED, AT LAST. In its new spot the boiler faces the other scotch marine unit. Both employ the same breeching to connect them to the chimney outlet

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men



CENTRAL SYSTEM FILLS OIL CUPS

SOME OF our refrigeration compressors are oil-cup lubricated. Originally the oiler filled these cups from a long-stemmed oil can, a method that did not work out satisfactorily. Some of the cups were inconvenient to fill, others were overlooked and went dry, some overflowed when filled and sometimes the oil-can stem broke the glass cups.

To correct this condition I mounted a 2-gal. tank *T* at the compressor's top, as in the photo. From the tank's bottom a pipe connection branches to all the oil cups. The end of each branch is reduced to go inside the oil-cup hole and about halfway down into the cup. A petcock in each line controls oil flow from the tank to the cups.

When the oiler fills a cup, he opens its petcock and watches until the cup is nearly full, then closes the cock. He repeats this operation until all cups are filled. This arrangement has eliminated the trouble. Cups are filled easily now and the only oil that has to be handled is that for filling the tank.

Brooklyn, N. Y. JAMES P CAREY

Vent Tube Corrects Lubricator Trouble

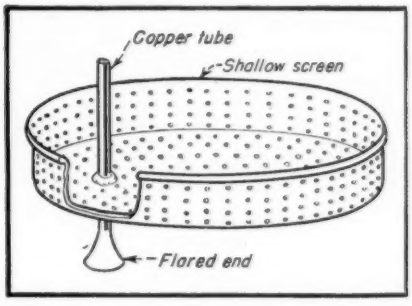
OUR STEAM-DRIVEN air compressors are equipped with forced-feed lubricators. These are divided into two sections: One pumps cylinder oil to the steam end and the other pumps air oil to the air end of the compressors.

At the air end of the lubricators the filling port screens are shallow, which caused trouble when filling the reservoirs. Because the vent was easily plugged and oil-sealed the screen, air could not escape from the lubricator and the oil could not flow in.

As a result the oiler would remove the screens before filling the reservoirs with air oil. The slippery screens were difficult to replace and sometimes fell into the reservoirs. Realizing that this was poor practice I decided to correct the difficulty.

What we needed was a better vent in the screens, so I drilled a hole through the bottom of each. In this hole I soldered a piece of copper tubing. The flared bottom end extended about ½ in. below the screen, while the other end extended an inch above, as in the diagram. This tube readily releases from the lubricators the air as it is replaced by oil but is not long enough to prevent putting the cover in place.

Since installing these vents the screens have not been removed. The



lubricators are easily filled, and impurities are prevented from getting into the reservoir with the oil. This might cause fouling of the lubricator unit, trouble in the compressor, or an unexpected shutdown.

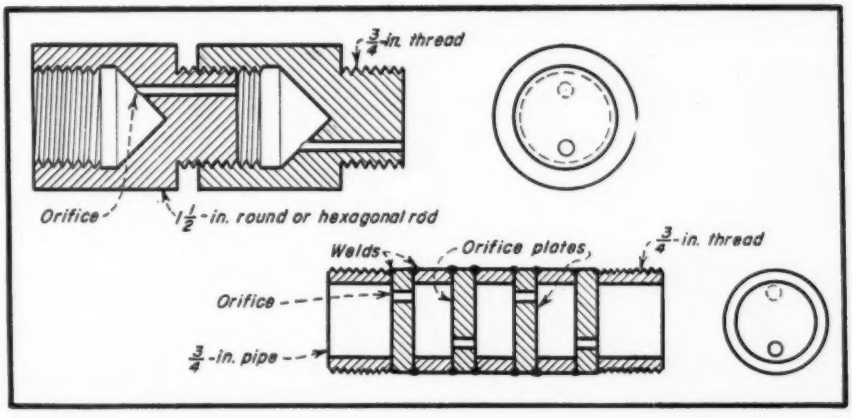
Paterson, N. J. F M GIORDANO

Orifice Size for Recirculating Line

CENTRIFUGAL BOILER-FEED pumps are frequently provided with recirculation connections so that they will not overheat or become steambound if flow to the boiler is stopped by either the feedwater regulator or the shutoff valve. Because of excessive pressure drop

through it, a single orifice in the recirculation line is noisy; therefore a series of orifices is frequently used. One orifice per 100 psi is sufficient to reduce the noise below the nuisance level.

Two designs of series orifices that I have used are shown in the drawings. In Fig. 1 the orifices are machined as single units from solid steel stock and threaded together to obtain the desired number in series. This construction gives flexibility because the number of orifices can be readily increased or decreased. The design in Fig. 2 has orifices made of steel disks, which are welded between short sections of recirculation pipe. A threaded section is welded on each end of the orifice assembly for connection into the recirculation line. Place orifice center lines 180 deg apart as shown in the figures.



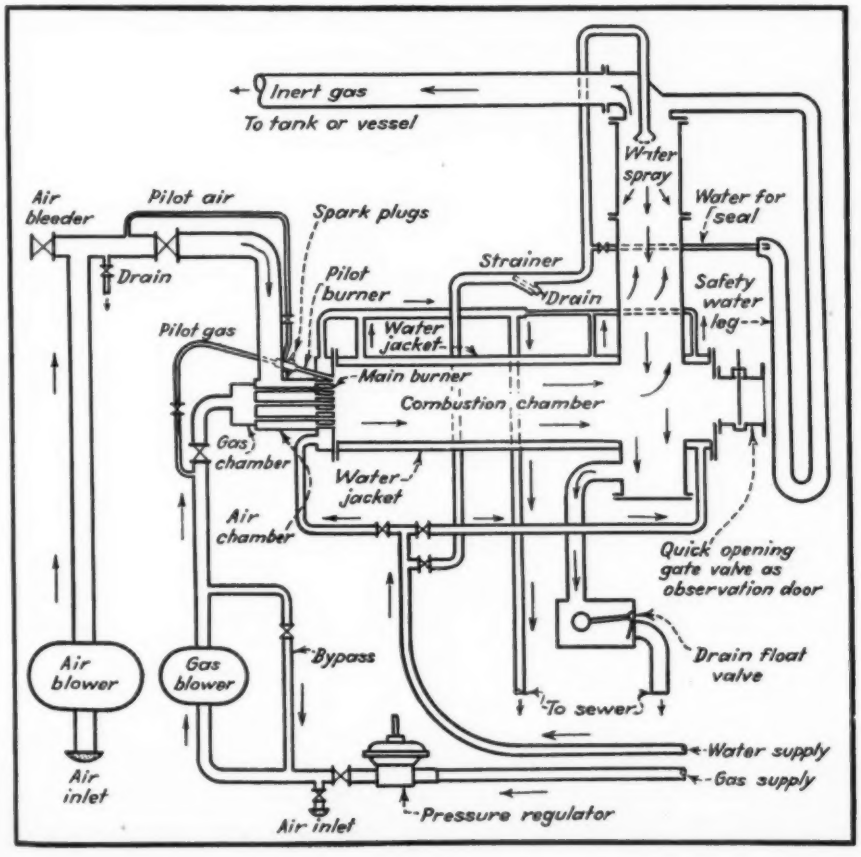
When calculating orifice size for a series, pressure drop across each equals total pressure divided by the number in series. As the number of orifices is increased their diameter must also be increased for a given flow. Thus, for 300 psi, if one orifice is used for 6-gpm flow the required size is ⅛ in., but for three in series, size is $\frac{3}{16}$ in.

Dorchester, Mass. N T Pef

PURGING ELIMINATES EXPLOSION HAZARDS IN TANKS

Illuminating and similar gas holders have to be emptied periodically for internal inspection and repairs. Before work can be done inside these holders the gas must be blown out and replaced with air. To do this and not create an explosive mixture presents a serious problem that we solved by designing and building a purging machine.

The diagram shows one of these machines, which is mounted on a truck trailer. A supply of illuminating gas and cold water is needed for the machine's operation. It consists of a water-jacketed combustion chamber connected to a gas and an air blower. The blowers, of a size to give air and gas proportions for best efficiency in the combustion chamber, are coupled together and driven by a gasoline engine. The gas burner is provided with a pilot that bypasses the main gas and air valves, as indicated.



After lighting the pilot flame by a spark plug, the main air and gas valves are opened to light the main burner. When lighting this burner the large quick-opening gate valve at the rear of the combustion chamber is left open to observe the flame and relieve any pressure that might develop from a puff when lighting the burner. Products of combustion are washed and cooled by going through a water spray in the combustion chamber. The water spray also insures against bits of incandescent material being blown into the gas holder. Spray water falls to a basin below the combustion chamber and drains to the sewer through a float-controlled valve. A water leg at the combustion chamber's rear serves as a low-pressure safety valve.

To connect the purging machine to a gas holder, a length of pipe is removed from the main gas line and both ends of the line blanked off so that gas cannot get by. Provisions are made in the gas holder's blind flange for connecting the purging machine.

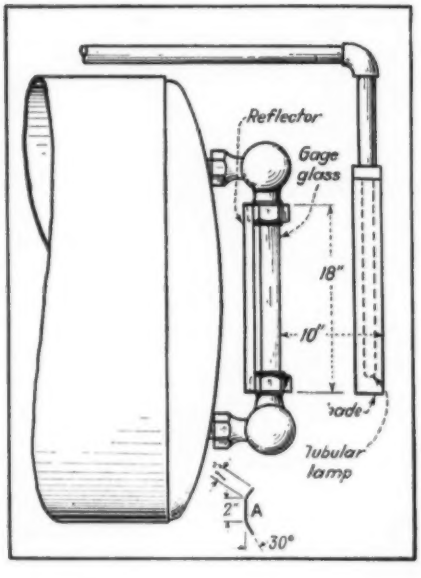
Inert gas from the purging machine blows into the gas holder and the gas is vented from the tank's top. Tests are made of the vented gas. When the tank is free of inflammable gas or vapor, the

gas blower is shut off and only air blown through the combustion chamber and into the gas holder. When air has completely displaced the inert gas, the gas holder is considered safe for workmen.

To put the gas holder in service air is blown out by inert gas from the purging machine; then the inert gas is displaced by illuminating gas. During no time of purging and filling does the holder contain an explosive mixture of air and gas.

The purging machine is not complicated or expensive to build. We have two: One produces 30 000 cu ft per hr of inert gas, and the other 15,000. Purging a gas holder required purge gas of twice the holder's volume. For purging an oil tank with residue in the bottom that contains residual vapors, purge gas is 2.5 times volume of tank. That is, if the tank has 1000 cu ft volume, then 2500 cu ft of purging gas is required to clear the tank of explosive mixtures. For purging small tanks exhaust from an automobile or truck engine can be used.

New York, N. Y. W E ROSSNAGEL



Lamp Spots Water Level for Fireman

THE DIAGRAM SHOWS how we solved the gage-glass lighting problem on our boilers. Because the steam drums are 30 ft from the operating floor and the boiler-room wall is only 15 ft from the boiler front, gage glasses have to be viewed at a steep angle. We tried the various methods described in POWER during the last 16 years, but with little success, so we decided to develop one.

We made a shade from 28-gage tinned steel, and bent it around a 110-v 40-watt tubular showcase lamp, with a narrow slot on one side. When the lamp is installed in the shade there is about 1-in. clearance between the two. Top and bottom of the shade are closed to prevent escape of light.

The lamp is installed directly in front of and about 10 in. away from the gage glass. Back of the glass we installed a polished tin reflector, 4 in. wide, bent to the shape shown at *A*.

This arrangement of light and reflector permits us to see the water level from any part of the firing aisle. In other boiler rooms a little experimenting will decide whether slightly different positions of the light and shade are necessary to see the water level to best advantage. Do not locate the shade so far away from the glass as to make the light ineffective, nor so close as to obstruct the glass.

Originally we used two 100-watt lamps placed so that their light came on the glass at about 45 deg from both sides. This method was effective on only a small section of the glass because the water level was difficult to see if it varied two inches either side of normal.

Dolbeau, Que. R A LANE

MAKE WRENCH TO OPERATE PLUG VALVES

USE OF AN S-WRENCH to operate a plug valve and to adjust the plug nut not only concentrates wear on a small portion of the plug valve but contributes to accidental injuries if the wrench is used carelessly. To avoid these faults the welder for one company made up a special wrench, which would fit the valve, but which would not pinch-hit for missing equipment elsewhere. Short sections of proper-size extra-heavy pipe were swaged to fit the square of the nut and plug respectively, and welded on opposite ends and sides of an 18-in. length of 1-in. pipe, as on the left in the photo. The wrench was offset slightly at each end, to increase clearance between pipe and wrench when the latter was used.

Being unsuited for other wrench service, there was no difficulty in keeping this unit close to the valve. Likewise by contacting the plug square or adjusting nut through 360 deg, more uniform pressure could be applied, and the valve manipulated with a minimum of effort.

Houston, Texas ELTON STERRETT

Heated Compressed Air Dries Motor Windings

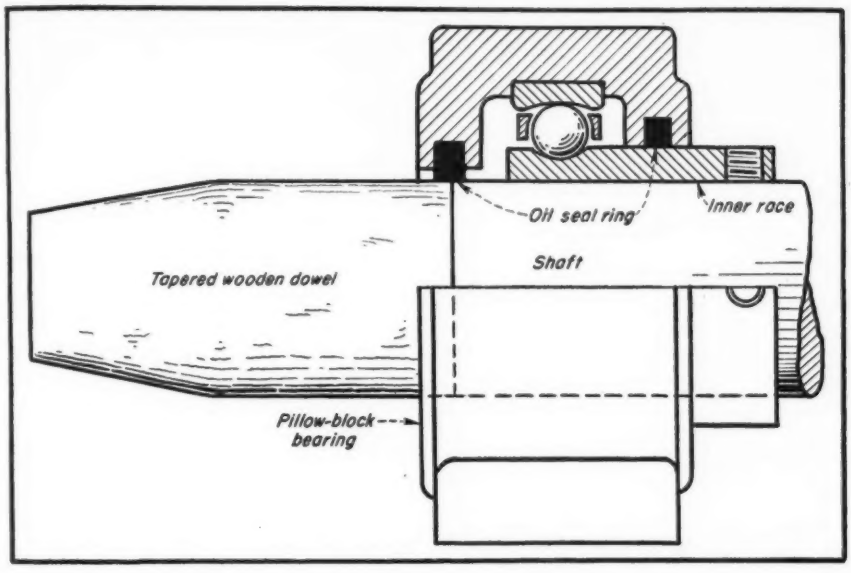
WHEN DRYING OUT electrical machinery some parts of the windings may be difficult to reach with the usual heating methods. Drying by passing a current

through the windings may be effective, but can be objectionable if the insulation resistance is low in spots.

When current leaks to the ground at these spots it may, by electrolysis action, carry metal into the insulation to form a dead ground or produce a permanent low-resistance spot. Even though the machine is dried out and put into service, low-current leakage through these spots in time causes an insulation failure and unexpected stopping of the machine.

Where warm air is available, using it to dry the windings is a safe method. but sometimes parts of the windings are not easily reached. For such conditions I have used low-pressure compressed air passed through a temporary heater. I made this heater from a piece of pipe between two hose lengths. One free end of the hose connects to the compressed-air supply and the other to a nozzle. A blow torch heats the center of the pipe, which in turn heats the air as it slowly blows through. The compressed-air valve is opened only sufficiently to give a mild draft of air from the hose nozzle, which is used to direct the air into hard-to-reach places.

W E WARNER
Woodford Green, England



TAPERED DOWEL SPEEDS BEARING ASSEMBLY

MOST PILLOW-BLOCK antifriction bearings have oil seal rings of smaller diameter than the shaft on which they fit. This makes it difficult to assemble the bearings on the shaft unless a means is provided to open the seals. I have solved this problem with a wooden dowel of the same diameter as the shaft, but tapered at one end.

The dowel is pushed, tapered end first, through the bearing until it rests on the dowel's straight section. The oil seal rings are now opened to the shaft's diameter. By placing the large end of the dowel against the shaft as in the figure, the bearing can be easily pushed from the former onto the latter. When the bearing is in its proper location its inner race is tightened to shaft by setscrews.

I have put pillow-block bearings, of ⅝, ⅞ and 1¼ in. size, on their shafts by this method, but there is no reason why it cannot be used on larger bearings. Before developing this method I saw mechanics work 10 or 15 min to get a bearing on its shaft whereas with the tapered dowel the job can be done in 30 sec. This is another example of a simple device that has proved to be a timesaver.

Drexel Hill, Pa. SAMUEL MARANO

Hints that Held in A Babbitting Job

WHEN BABBITTING a solid bearing put a little white lead on the mandrel to make it easy to remove from the metal after pouring. When babbitt space is thin a little rosin in the babbitt makes it pour true and even. Heat the bearing shell and mandrel before pouring the metal to avoid chilling and excessive contraction of the babbitt away from the shell.

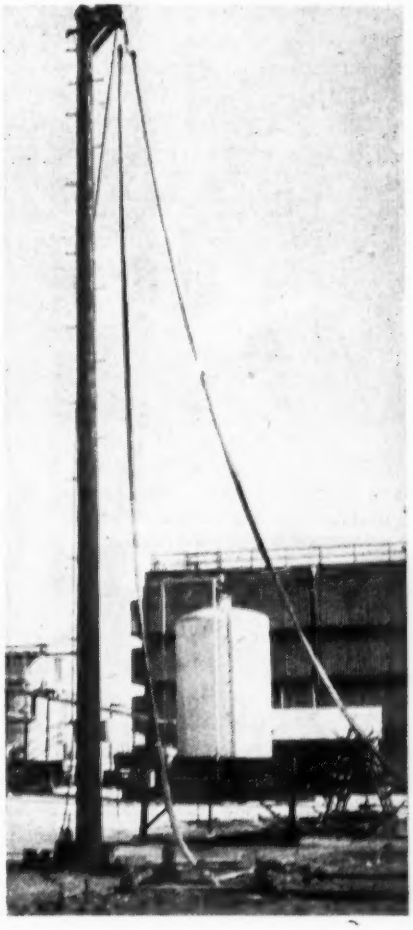
St. Louis, Mo. O C MILLS

Suspends Fabric Hose For Quick Drying

AFTER USING fabric fire hose all moisture must be removed from its interior to prevent wet rot caused by mold. To accelerate drying one company made a device, and attached it to a tall lamp pole, as in the photo, so that the hose lengths are suspended vertically. To one end of a crossarm on the pole a small sheave is fastened, through which a light rope runs.

One end of this rope connects to a counterweight and the other to a short piece of lumber resembling a farm "single tree" having a clamp at each end for connecting two lengths of hose. Snubbing the counterweighted end of the rope holds the hose suspended while drying.

If the hose lengths are extra long,



their lower ends may be snubbed to a stake some distance from the base of the pole. This holds the hose at an angle to give sufficient drainage drop so that water dissipates readily, particularly with the sun shining on the outside fabric.

Chicago, Ill. CHAS A ARMSTRONG

READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

How Can I Stop Belt Slippage on Flywheel?

WE HAVE TROUBLE with slippage of a belt that drives an ac generator from a steam engine. The unit, an 18x42-in. 400-hp corliss with a 15-ft flywheel, has a 28-in. face. The engine runs about 102 rpm and drives a 275-kw 60-cps ac generator through a 34-in. pulley. Generator speed is 514 rpm. Belt is 28 in. wide, of 3-ply leather. Center-to-center distance from generator pulley to engine flywheel is 20 ft, 8 in. A heavily weighted idler at the generator gives a good belt wrap on its paper pulley. Usually the generator runs synchronized with an outside power source.

Trouble is that when we carry a heavy load of about 250 kw on the generator the belt slips on the engine flywheel, as the polished condition of the metal flywheel face shows. Slippage heats the belt noticeably and is shortening its life considerably.

I have heard that a rider belt, about half the width of the main belt and riding on top of it, greatly helps this condition. Do POWER readers agree or have they a better solution?—*IM*

Improved Reader Service

INTEREST IN Reader's Problems has grown to the point where lack of space prevents publication of all acceptable answers. To do justice to a reader asking a question, and to those answering it, we shift this month to one question instead of two.

Your answer now has a better chance of being published, so don't hesitate to send it in. Also, if you have any question, send it along—the best engineering talent in the field (your fellow plant operators) will answer it.—*Editor*

Answers to July Questions

Can I Make Power and Heat With Exhaust Steam?

(This is Question 1 from the July issue, with best answers from readers)

We are planning an expansion to our building, and I am gathering data on the power requirements. At present, we purchase electric power for a 30-kw light and power load. Power bill runs about $85 per month.

We have two boilers: One is a low-pressure unit for heating. The other, a 300-sq-ft 125-psi "Economic," furnishes steam for hot water and laundry; it also supplies low-pressure steam for heating some of the rooms. We burn 350 to 400 tons of coal a year, for which we pay about $8 per ton. Plans call for enlarging our building from 154,300 cu ft to 300,000.

I would like to know whether we can generate our power and heat the building economically with exhaust steam. Our plant is in northern New England where a temperature of 10 below is not uncommon. I estimate that 50 kw of power will supply the load to start, although this amount might increase over a period of years. Can we use our present boilers, or will we have to purchase a complete new plant? How many cu ft of room volume can be heated per sq ft of radiator surface? Can someone tell me about how much steam is required?

If POWER readers can answer these questions, the information will help me sell the idea to the management before plans crystallize. Charts or diagrams of similar plants might help me put over my arguments.—AHP

Power and Heating Load Require Special Study

AHP CAN GENERATE power and use the exhaust steam for building and water heating. To determine whether he can do it economically requires a study of his estimated annual power bill, and fixed and operating costs of his generating unit. From information given the exhaust steam available, about 300 lb per hr, is not enough to supply the heating-system load in cold weather. Since these requirements are about 1000 lb per hr live steam must make up the difference. In mild weather or in summer enough power can be generated so exhaust steam can be used to heat water. He should purchase any additional power from a power company. Standby service should be maintained even if *AHP* decides to generate his own power since it will undoubtedly prove less expensive than installing a complete reserve unit.

If he obtains normal efficiencies, I estimate his plant will produce about 5,500,000 lb steam annually at present, of which about 1,500,000 lb are used for heating and the remaining 4,000,000 in his process load.

If process load doubles, which is a reasonable surmise since his building size is being doubled, then this load with the increase in heating will require additional capacity, probably about 40 hp. He could obtain this by adding a boiler. All three boilers should be connected with a pressure-reducing and safety valve on the high-pressure line to the low-pressure boiler. This eliminates running the low-pressure boiler in fall and spring where heating requirements could be met by feeding live steam from the other boilers. This would save fuel because the fire would not be started and kept

(*Continued on page* 154)

What Is Best Way to Save Engine Cooling Water?

(This is Question 2 from the July issue, with best answers from readers)

In the past we have always dumped the jacket cooling water from our two diesel engines. I would now like to store part of this water in a 1000-gal tank on the roof, and use it in a small laundry. If we let the water flow into the tank at the top, and also overflow from the top, we won't get much hot water into the tank for storage.

I know that the engine jackets cannot stand full pressure; therefore city pressure cannot be used to force hot water into the tank. What is best method of getting water into the tank? How should it be circulated to maintain it at the hottest temperature? —RCE

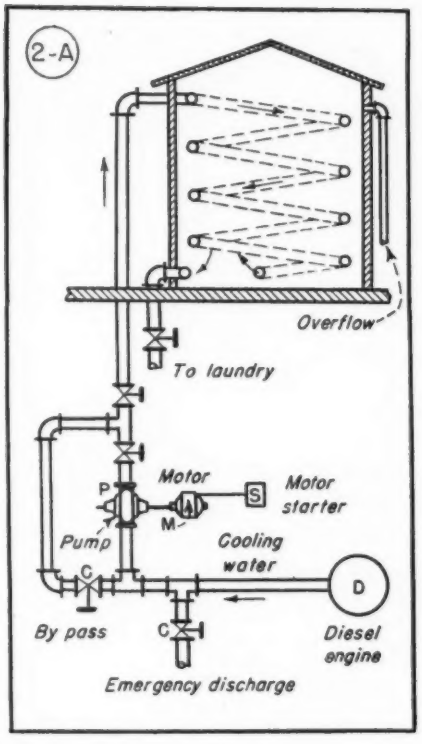
Storage Pit Cheaper Than a Roof Tank

RCE WANTS TO SAVE diesel-engine cooling water, and store part of it in a 1000-gal tank on the roof. Fig. 2-*A* suggests one method. Note that pump is motor driven and provision made for emergency discharge of cooling water in case of a pump shutdown.

Cooling water is put into the tank through a series of pipes mounted around the inside. Water discharges into the bottom and overflows at the top. Piping arrangement inside the tank helps keep the temperature fairly well equalized. This method, however, is expensive because of cost of piping to the roof as well as inside the tank.

I suggest, instead, a storage pit under the basement. Cooling water could then be discharged directly into the pit from the diesel engines by gravity or city-water pressure. An overflow could be arranged at the top. The pit should be covered with boards. Since it is built in the ground there is minimum heat loss and ample hot water at all times. This arrangement requires less piping. The pump could be adjacent to the pit and run only when the laundry needed hot water. I think the latter would be a cheaper installation and simpler to operate.

Tenafly, N. J. K B HOFFMAN



Install Sump Tank To Collect Discharge

RCE'S ARRANGEMENT could be installed as in sketch 2-*B*. Sump tank overflow line must be large enough to accommodate all jacket water during pump stoppage. Pump need not be capable of handling all jacket water. Also, it need operate only at intervals to reheat or refill roof tank. It may, if desirable, be connected to thermostatic or float switch.

Roof tank should be covered but vented and, if possible, insulated to reduce heat loss. Roof-tank overflow line should extend near bottom of tank, opposite inlet line.

Muskegon, Mich. R H FREYE

Discharge Overflow From Bottom of Tank

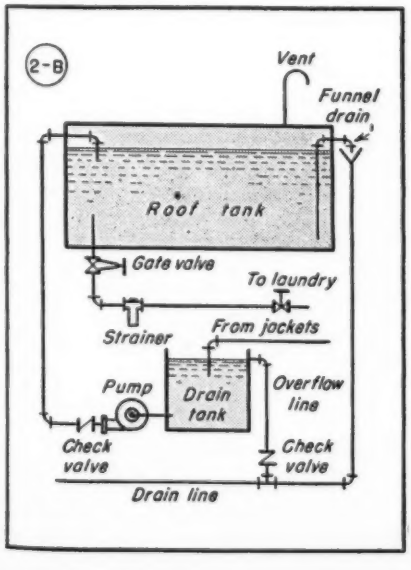
As RCE'S ENGINE JACKETS will not withstand pressure necessary to run water to the roof, he needs a pump. With the setup in sketch 2-*C*, hot water from the tank will be available to the laundry. All surplus water runs off from bottom of tank. Vent the siphon.

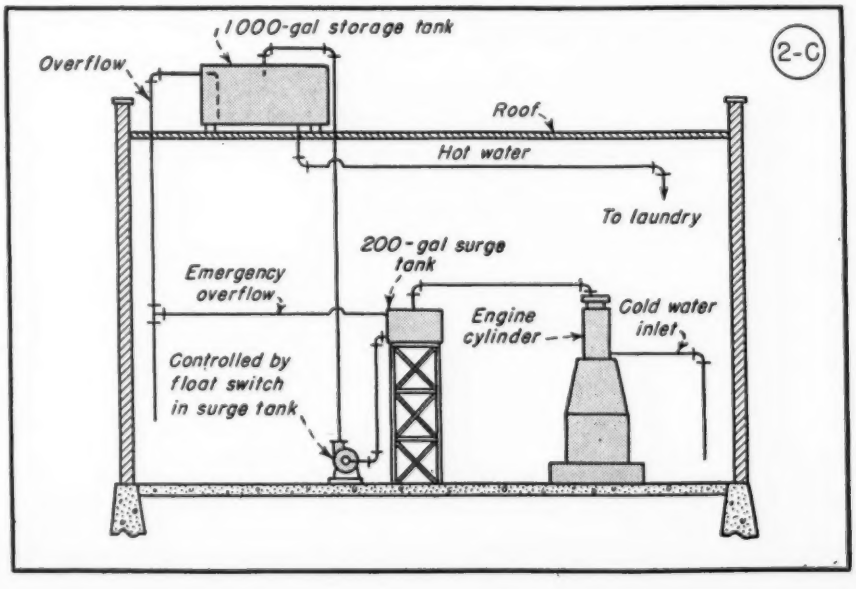
Laundry requirements should determine difference in height of storage-tank overflow and laundry supply line.

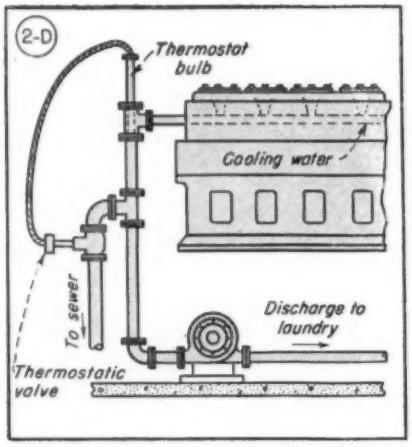
Kenmore, N. Y. R E FONTAINE

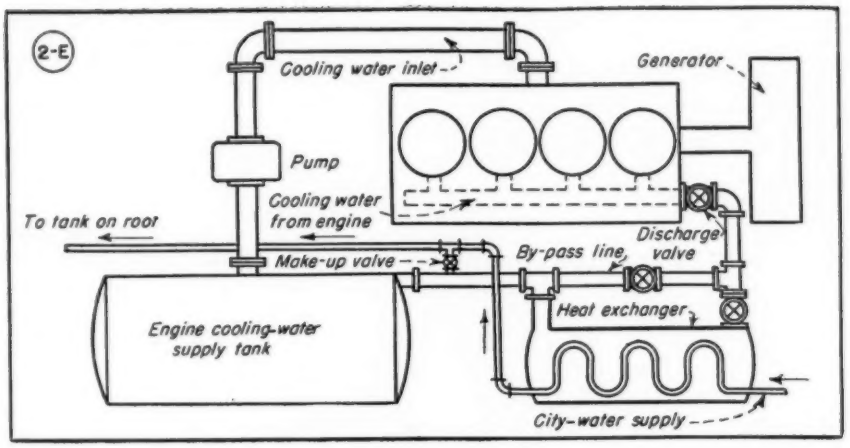
Pump Water Straight From Engine to Laundry

PRESUMABLY *RCE* proposes using some cooling water in the laundry and storing the remainder. So he should install a centrifugal pump adjacent to the engine and pump water to roof tank.









Regulate tank-water level with a float valve. In using a tank on the roof it is necessary to lag it properly. If the system is in a section where weather is severe in winter, even this arrangement may not prove satisfactory.

Sketch 2–*D* shows another arrangement that answers the same purpose. By installing a centrifugal pump alongside the engine and pumping direct to the laundry with a thermostatic valve installed in a bypass to the sewer, it is possible to pump water to the laundry without a tank. Hotter water could be obtained for the laundry by keeping all piping inside the building, and well lagged. The element of the thermostatic valve can be set at any desired temperature, so when demand from the laundry drops the valve opens to sewer, and thus eliminates overheating the engine.

Dolbeau, Que. R A Lane

Heat Exchanger Will Save Most of the Heat

Best way to save diesel-engine cooling water is to have a receiver and heat exchanger, then to have the cooling water treated. Treat water in closed part of system to reduce scale in the engine jackets. When water is treated by compound, its use for laundry service isn't practical. Best method to maintain cooling water at an even temperature is to throttle the discharge valve located as in 2–*E*. Maintain cooling water at an even temperature of about 180 F, which is a good value for winter as it makes ignition easier and reduces strains on engine jackets. Temperature could be carried at 160 F in summer.

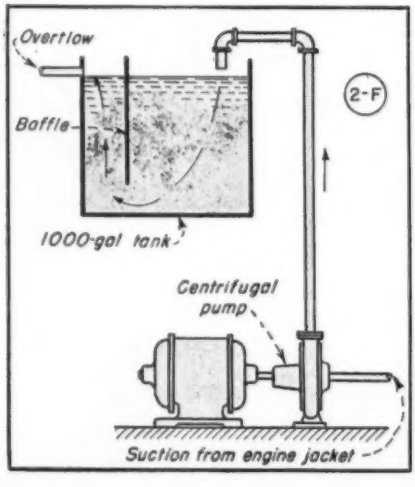
This may not be the best way to save engine cooling water but it is better than the system *RCE* uses now.

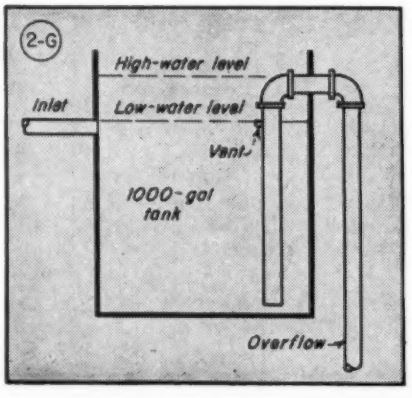
Philadelphia, Pa. W T Mullen

Put Baffle Plate in Tank

The simplest way to solve *RCE's* problem is to install a small centrifugal pump to raise the discharged water from engine jacket up to the 1000-gal tank on the roof. Water could be discharged into the open tank as in sketch 2–*F*. Water would have to flow under the baffle plate before passing to the overflow. This maintains steady flow in one direction and results in continuous hot water. A cheaper way might be to extend inlet pipe to bottom of tank and omit baffle plate.

Zanesville, Ohio J P Bartels



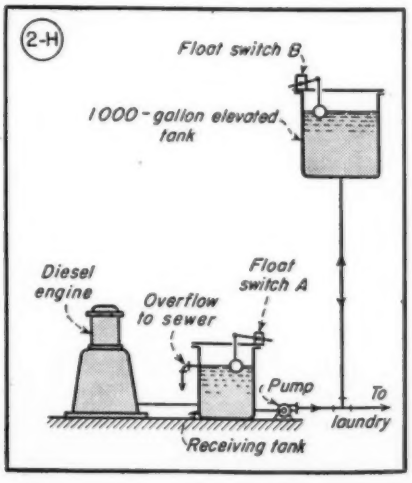


Reclaim Waste Heat From Engine Exhaust

First thing *RCE* should do is make some changes in his cooling system. I assume he is cooling his engines by cracking a valve and letting city water run through the engine, then to sewer. Assuming the supply water to be 80 deg, and allowing for a 15-deg rise (more than efficient engineering practice) and a 5-deg drop for radiation, the laundry is getting water 10-deg warmer than tap water on a warm day. It wouldn't be worth while.

What he should do is cool and recirculate jacket water and install a waste-heat boiler on one of his stacks. This gives really hot water, which he could circulate as he would in any other heater.

If he still wants to use the storage tank he can keep it for discharge water. First, catch water in a hotwell, then pump it to the tank. Use a pump larger



than the water demand. Discharge water just below the high-water level in the storage tank as determined by the siphon vent, in 2–*G*. Take overflow from bottom of storage tank with a vented siphon.

Santa Rosa, N. M. TOM NICHOLS

Float Large Tank On Line for Storage

SKETCH 2–*H* SHOWS the arrangement I recommend. Since the engine jackets cannot stand high pressure, it is necessary to use a small receiving tank as in the diagram. This tank should have a capacity of only about 5 min at the flow rate the pump provides. Float switch *A* stops the pump on low water in the receiving tank. This prevents damage if cooling-water flow ceases while the pump is running. An overflow to the sewer carries away excess cooling water.

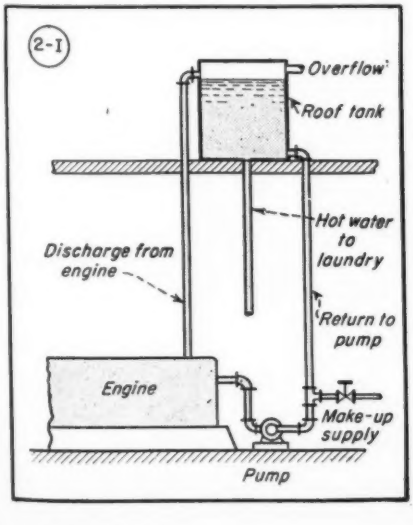
In this setup, with the 1000-gal elevated tank "floating" on the line, minimum heat is lost. When laundry demand exceeds pump capacity, flow takes place from the elevated tank. When laundry demand falls below pump capacity, flow takes place to the elevated tank. Float switch *B* stops pump when elevated tank is full.

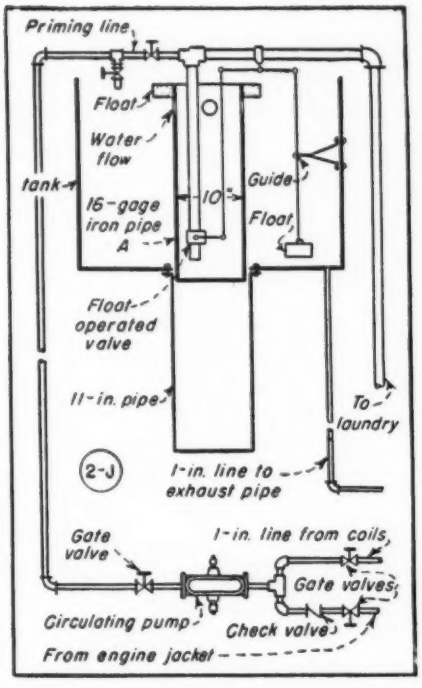
Insulating the receiving and elevated storage tank may be warranted if cooling-water temperature is fairly high.

New York, N. Y. DURANDO MILLER

Recirculate Cooling Water With a Pump

RCE ASKS HOW TO circulate water from his diesel engines. He does not give height of roof where he wants to place his storage tank, but I doubt if it is high enough for pressure to endanger





the engine jackets. If he uses the scheme in sketch 2–*I* he should have no trouble. Makeup water can be added either automatically or manually from city mains. Cooling-water temperatures generally run below 125 F, but on certain engines this limit can be exceeded. The engine manufacturer can supply this information.

Since the pressure or head of water is about the same on both sides of pump, power is required only to overcome friction losses. A small motor will drive the pump.

Carlsbad, N. M. E A ROBERTS

Trap Hot Water in Tank

TO HAVE HOTTEST WATER on tap at all times, I suggest method in 2–*J*. Install tank with 11-in. dia pipe extending below to accommodate 10-in. 16-gage iron pipe. Make other connections as shown. In operation, floats support pipe *A*. This allows hot water to flow into *A*, through openings at top, and out through 2-in. line to laundry.

Use circulating pump to take water from engine jacket or storage tank, and circulate it through copper coils around engine exhaust pipe, thereby picking up heat and insuring water at all times.

Install float-operated valve on lower end of laundry feed pipe. If water gets too low in tank, float closes valve so as not to break siphon. Install priming line from circulating pump if float valve fails.

Quincy, Fla. D J PARMER

Divert Hot Water Direct to Laundry

BEST WAY TO GET water into *RCE's* tank is by a pump on the outlet side of the water jacket. I suggest piping scheme in sketch 2–*K*. It shows that the water should be taken from the tank bottom, not the top. This water will be cooler than the incoming water but during periods of heavy laundry demand the tank inlet and outlet temperatures will be almost equal.

To obtain the hottest water possible a tank bypass should be fitted as shown. Water flow to the laundry may be regulated by an automatic or hand-controlled valve. Laundry demands should be carefully studied before bypass pipe size is determined. If the demand is steady it might be possible to eliminate the tank altogether and supply the laundry by this line alone.

RCE should note that maximum water temperature obtainable on outlet side of water jacket is 120 to 130 F. If this is not hot enough steam heating coils may be added to tank, as shown in the sketch.

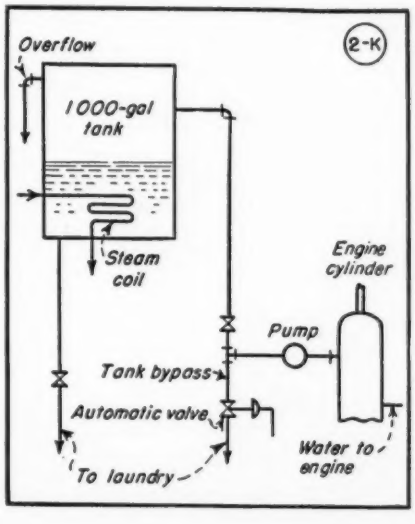
As a further precaution *RCE* should have his tank well insulated if exposed to the weather. Insulation could be applied directly to the tank or a small shack built around it.

New York, N. Y. T G HICKS

Use Engine Exhaust To Heat the Water

I SUGGEST that *RCE* use the exhaust gas from his diesel engines to heat the water. This can be done by passing all or part of the exhaust from the engines through a heat exchanger or a low-pressure vertical boiler for waste heat.

(Continued on page 158)



ROTARY-PUMP Q&A FOR POWER ENGINEERS

By A M SHAW

1—Types of Construction and Operation

First of a series in which A M Shaw, application engineer, rotary pump division, Worthington, selects questions and answers that give a practical understanding of construction, operation, characteristics, troubles and remedies.

Q 1—What is a rotary pump?

A—It consists of a fixed casing, containing gears, vanes, pistons, cams, segments, or screws. It operates with minimum clearances in such a way that a positive displacement of liquid occurs with each rotation of the drive shaft.

Q 2—What is a gear rotary pump?

A—It has two or more gears so contained in a casing that the liquid first fills the spaces between the gear teeth as they separate on one side, then is carried around and squeezed out as the teeth mesh on the other side, Fig. 1. The gears may have spur, single helical or herringbone teeth. If one gear is interally cut the pump is called an internal-gear rotary, Fig. 2.

Q 3—What is a vane rotary pump?

A—It has a cylindrically shaped rotor cut to contain sliding vanes, Fig. 3, or swinging vanes or buckets, Fig. 4. When rotated in an eccentrically bored casing the rotor causes the liquid to be drawn in on the side and discharged on opposite side. In modifications of this general type where blocks or rollers are used instead of vanes the operating principle is the same.

Q 4—What is a cam-and-piston rotary pump?

A—An eccentrically mounted cam, rotated by a shaft in the center of a

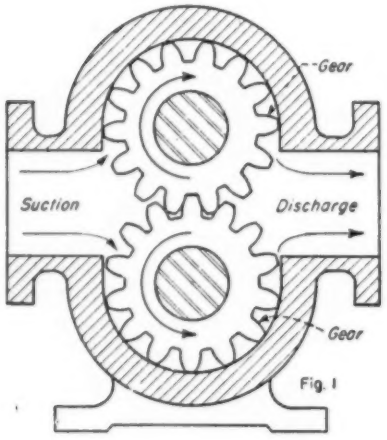


Fig. 1

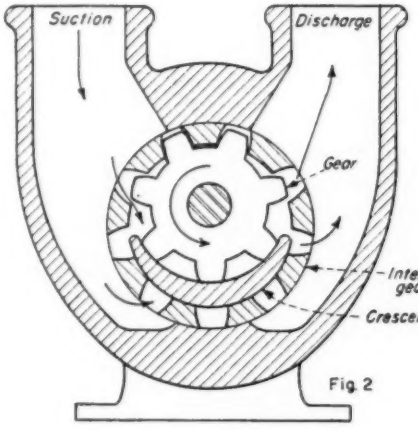


Fig. 2

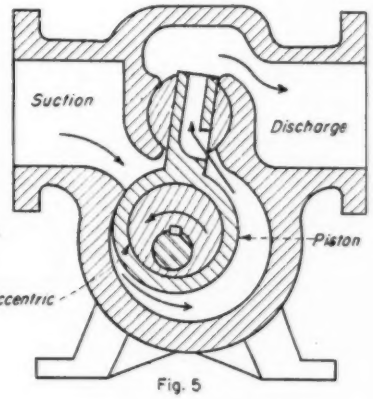


Fig. 5

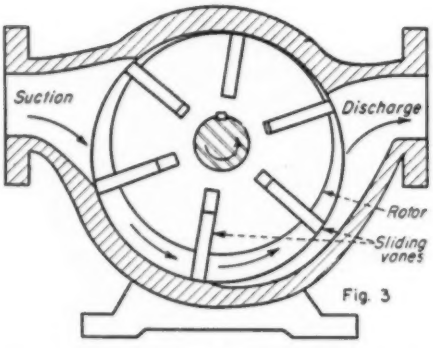


Fig. 3

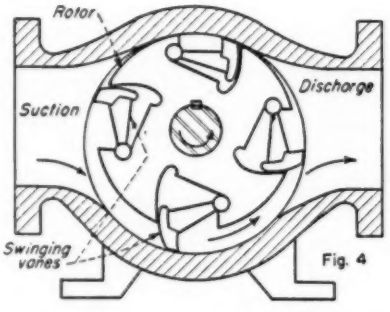


Fig. 4

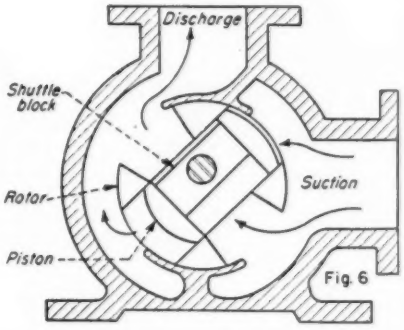


Fig. 6

Fig. 1—Gear pumps have spur, helical or herringbone teeth. Fig. 2—Internal-gear rotary pump. Fig. 3—Sliding-vane pump has cylindrical rotor eccentric to casing bore. Fig. 4—In swinging-vane pump, four arms in rotor support swinging vanes. Fig. 5—Cam-and-piston pump has eccentrically mounted cam rotating in center of cylindrically bored casing. Fig. 6—Rectangular slot, in rotor of shutttle-block pump, contains shuttle block and piston

—But not bothered

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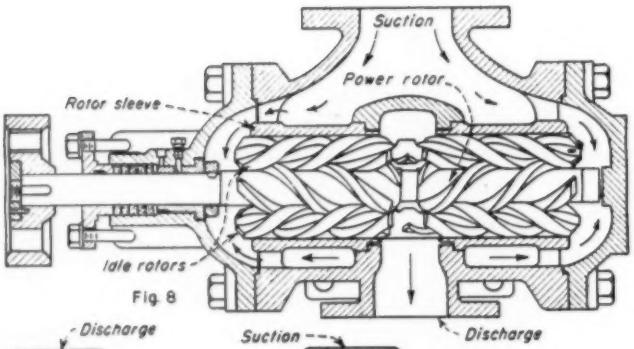


Fig. 8

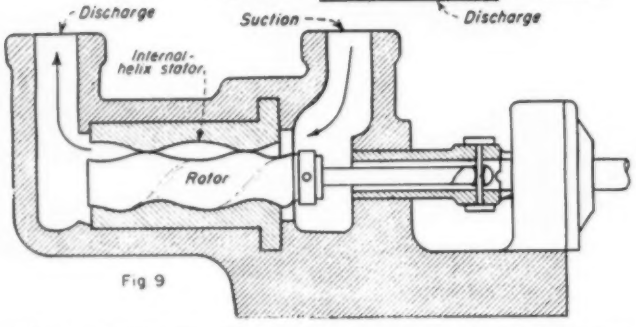


Fig. 9

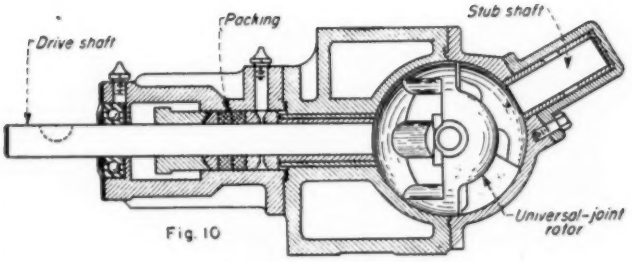


Fig. 10

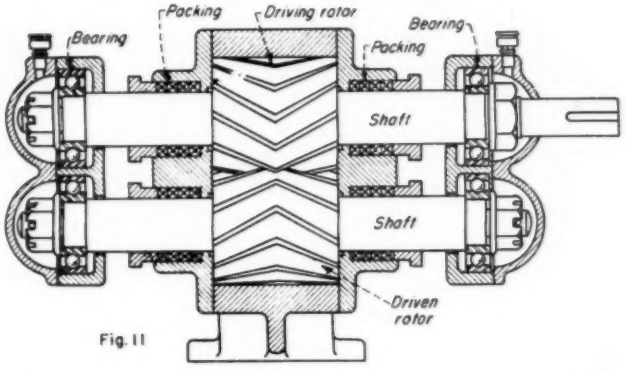


Fig. 11

Fig. 8—Screw pump with one power and two idle rotors. Fig. 9—So-called single-screw pump has spiral rotor that rotates eccentrically in internal helix. Fig. 10—Cross-section through pump that operates on principle of universal joint. Fig. 11—Pump bearings are outside packing away from the pumped liquid and can be separately lubricated

cylindrically bored casing, carries a strap with abutment or follower, called a piston. Each rotation of the eccentric causes a positive quantity of liquid to be displaced from the space between casing and piston, Fig. 5.

Q 5—What is a screw pump?

A—It has one, two or three screws, Fig. 8, rotated in a close-fitting casing. The liquid flows between the screw threads along the axis of the screws. Two- and three-screw pumps are often built with opposed screws to eliminate end thrust. In these units the liquid is drawn in at the outer ends of the screws and discharged in the center. So-called single-screw pumps, Fig. 9, consist of a spiraled rotor, which rotates eccentrically in an internal-helix stator or liner.

Q 6—What is a shuttle-block rotary pump?

A—This pump, Fig. 6, contains a cylindrically shaped rotor with a rectangular crosscut containing a shuttle block and piston, which is made to reciprocate within the rotor by a stationary pin mounted eccentrically in the concentric casing.

Q 7—What is a lobe rotary pump?

A—This pump, Fig. 7, usually has two rotors with two, three or four lobes, so synchronized that the rotors operate together as a gear pump does.

Q 8—What is a universal-joint pump?

A—This unit, Fig. 10, consists of a spherically bored casing with two shafts operating at an angle with each other, on which are two partial segments of spheres. As one rotor drives the other, a spherical wedge-shaped space enlarges and contracts, causing the pumping action.

Q 9—What is the casing on a rotary pump?

A—It consists of the pump body and the end covers, which are often called end plates or sideplates.

Q 10—What is the rotor?

A—The rotor is that part mounted on the drive shaft; it is the principal pumping member.

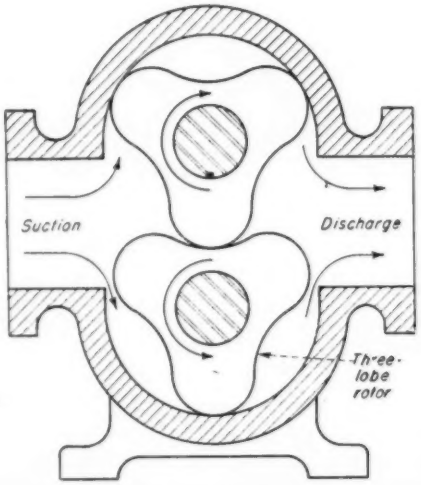


Fig. 7—A lobe pump usually has two rotors with two, three or four lobes

Q 11—What is the rotating element?

A—The rotor, or rotors, with necessary shafts, vanes, blocks, pistons, cams, screws and other parts that rotate within the pump, are considered the rotating element or elements.

Q 12—What kind of bearings are used in rotary pumps?

A—Practically all kinds are used in the wide variety of pumps on the market. Sleeve bearings of various materials are used extensively for lighter loads. Ball-radial and thrust bearings are necessary in some designs. Tapered-roller bearings are sometimes found on large pumps where radial and thrust loads must be carried. For heaviest radial loads, where easy disassembly is desirable, straight roller bearings are employed.

Q 13—What are internal bearings?

A—They are inside the packing and depend on the liquid pumped for most of their lubrication. With internal bearings this liquid must not affect bearing performance. Liquids that corrode, abrade or distort a bearing should not be handled in an internal-bearing rotary pump.

Q 14—What is meant by external bearings?

A—This term, applied to rotary pumps, means that the shaft bearings are separated from the liquid pumped by stuffing boxes, mechanical seals or other means, Fig. 11.

(*Continued on page* 142)

Tops FOR TOP PRESSURES

On steam lines where pressures go as high as 1500 psi, and temperatures up to 900° F. are encountered, steam traps must be rugged . . . and *efficient!*

That's why so many public utilities and other high pressure steam plants are installing Yarway Integral Strainer Impulse Steam Traps. First cousin to the famous standard Yarway Impulse Steam Trap, the integral strainer trap has been developed especially to meet high pressure trapping requirements.

It has ample condensate capacity when system is being "warmed up." Yet it will handle relatively small amounts of condensate efficiently without losing prime. The valve closes positively in the presence of dry or superheated steam.

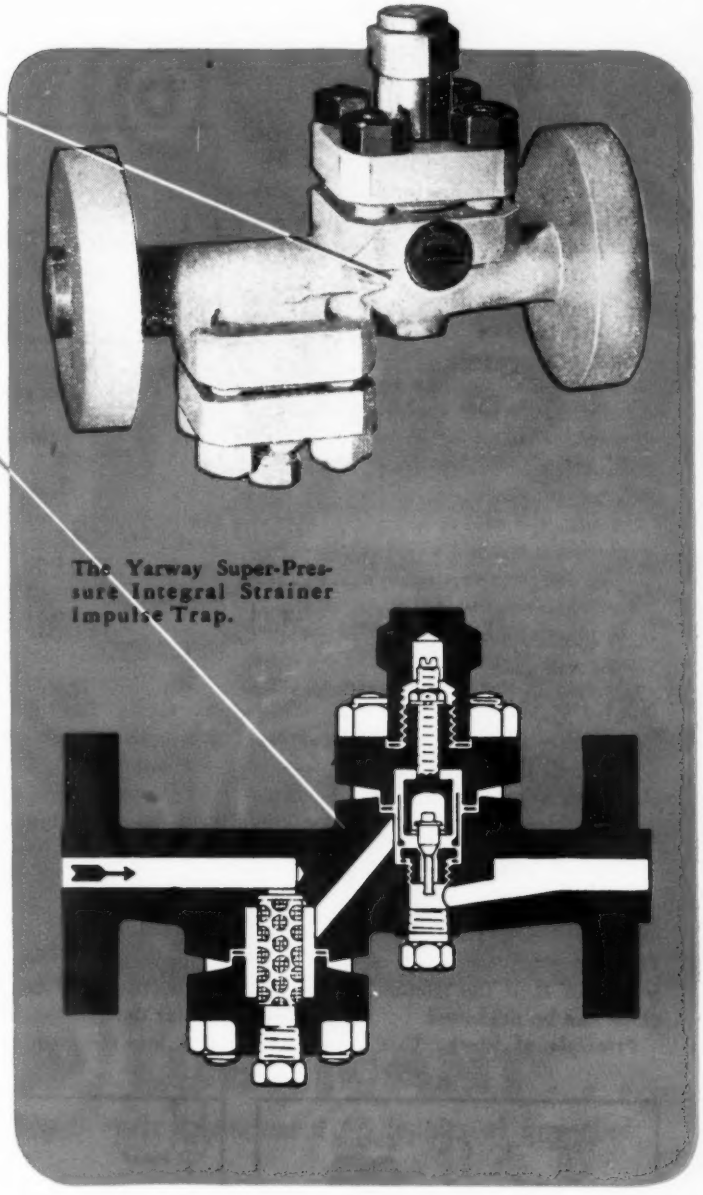
It is a fraction of the size and weight of other type traps designed for the same service—saving space, simplifying installation and requiring no supports.

It is suitable for all pressures within a wide range without change of valve or seat.

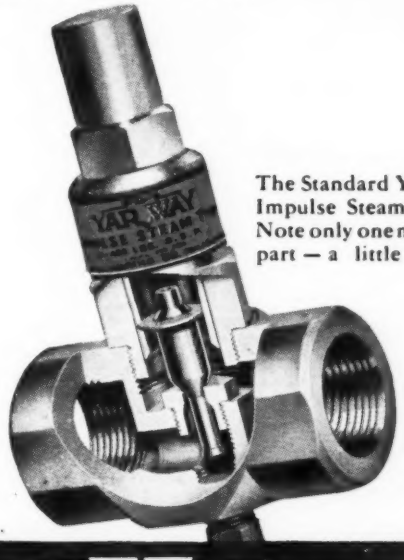
It has the same simplicity of design as does the standard Impulse Trap shown below—only one moving part, the same little valve.

Its integral strainer protects trap against scale and rust in the piping system.

Available with flanged or socket weld connections. Write for Bulletin T-1739.



The Yarway Super-Pressure Integral Strainer Impulse Trap.



The Standard Yarway Impulse Steam Trap. Note only one moving part — a little valve.

See these traps and other Yarway steam plant equipment . . . hear their operation described by Lowell Thomas in the Yarway color motion picture, "There Is An Engineering Reason." Available without charge for group showings. Write today.

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YARWAY IMPULSE STEAM TRAP

MATH TIPS

PHIL SWAIN GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS

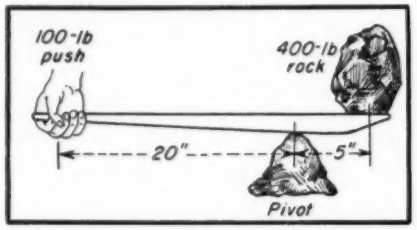
How to Figure Leverage: I

► FIG. 1 SHOWS A MAN'S HAND pushing down on a crowbar to lift a rock. The hand is four times as far from the fulcrum as is the rock being lifted, so the "mechanical advantage" is four to one. In short, neglecting friction (which would be small here) a 100-lb push lifts a 400-lb rock.

It is not always realized that the simple lever is just one special case of a general rule that applies to all kinds of machine parts—bellcrank lever, derrick, gearing, pulley drive, block and fall, wedge, screw, etc.

In fact, the rule is so general that it works even where the actual construction of the machine or device is completely hidden and secret, as in Fig 2. Here you don't know what's in the box except that if you push down steadily on handle *A*, platform *B* moves steadily upward a much shorter distance.

Evidently this is a device for *increasing force*. How much? Measurement shows that moving the handle down seven inches raises the weight platform one inch. Since the output movement is one seventh of the input movement, this output force must be seven times the input force. This means that a 100-lb down push on *A* will lift a 700-lb weight at *B*, if the friction in the machine can be neglected.



1 Here the mechanical advantage is 4 to 1 or, more simply, 4, so that a 100-lb push will lift a 400-lb rock

Principle of Work. This rule naturally follows from the "principle of work": *If nothing is wasted in friction the work output of any mechanical device equals the work input.*

Now work equals force multiplied by the distance the point of application of the force moves in the direction of the force. If a 3-lb weight is lifted 2 ft against gravity the work is $3 \times 2 = 6$ foot pounds.

To keep the input product of force times distance equal to the output product the machine pictured must have an output force seven times as great as the input force.

You never get any more work out of a machine than you put in. Assuming no friction, all gearing or levers or similar devices can do is to change the work into the form most convenient for the given purpose, either increasing force and decreasing distance on the one hand, or decreasing force and increasing distance on the other.

Here's another way to put the rule: *A machine can increase force at the expense of distance or can increase distance at the expense of force.*

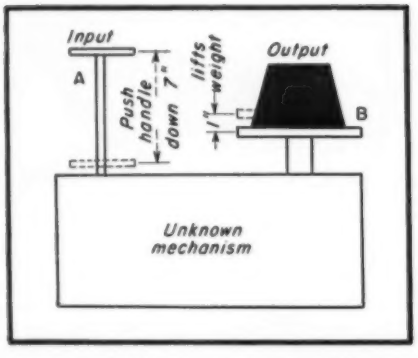
Fig. 3 Explained. Fig. 3 shows a beam used as a lever to raise a 3-ton load with a 1-ton hoist. Since the hoist chain at the left is three times as far as the load from the right-hand pivot, the load on the hoist will be one third of 3 tons, or 1 ton.

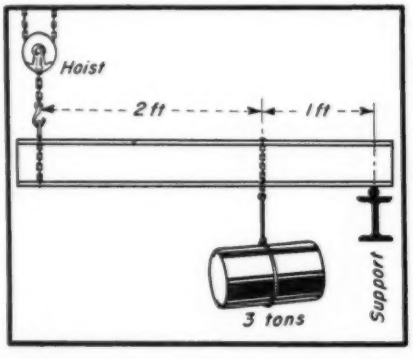
What about the load on the right-hand support. The answer is easy to get by either of two methods. Simplest is to remember that the hoist and the right support together must carry the total load of 3 tons. Since the hoist carries one ton, the remaining load on the right support is 2 tons.

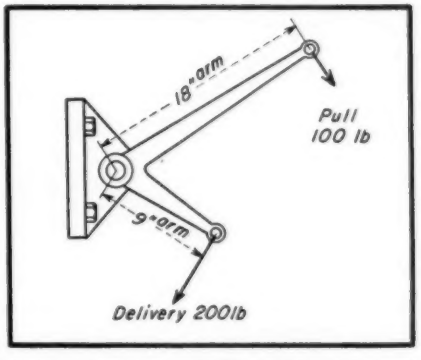
The other way is to use the rule of levers again, this time calling the left support the fulcrum. Then the lever arm of the 3 ton load is 2 ft, and of the right support is 3 ft, so the force on the right support will be $\frac{2}{3}$ of 3 tons $= 2$ tons.

Bellcranks. The principle of levers is as easy to apply to a bell crank lever as to a straight lever, particularly if the push or pull on each arm is at right angles to the arm. In Fig. 4 the arm length ratio is two to one, so any push on the 18-in. arm delivers double force at the 9-in. arm.

Next month, more tips on leverage.

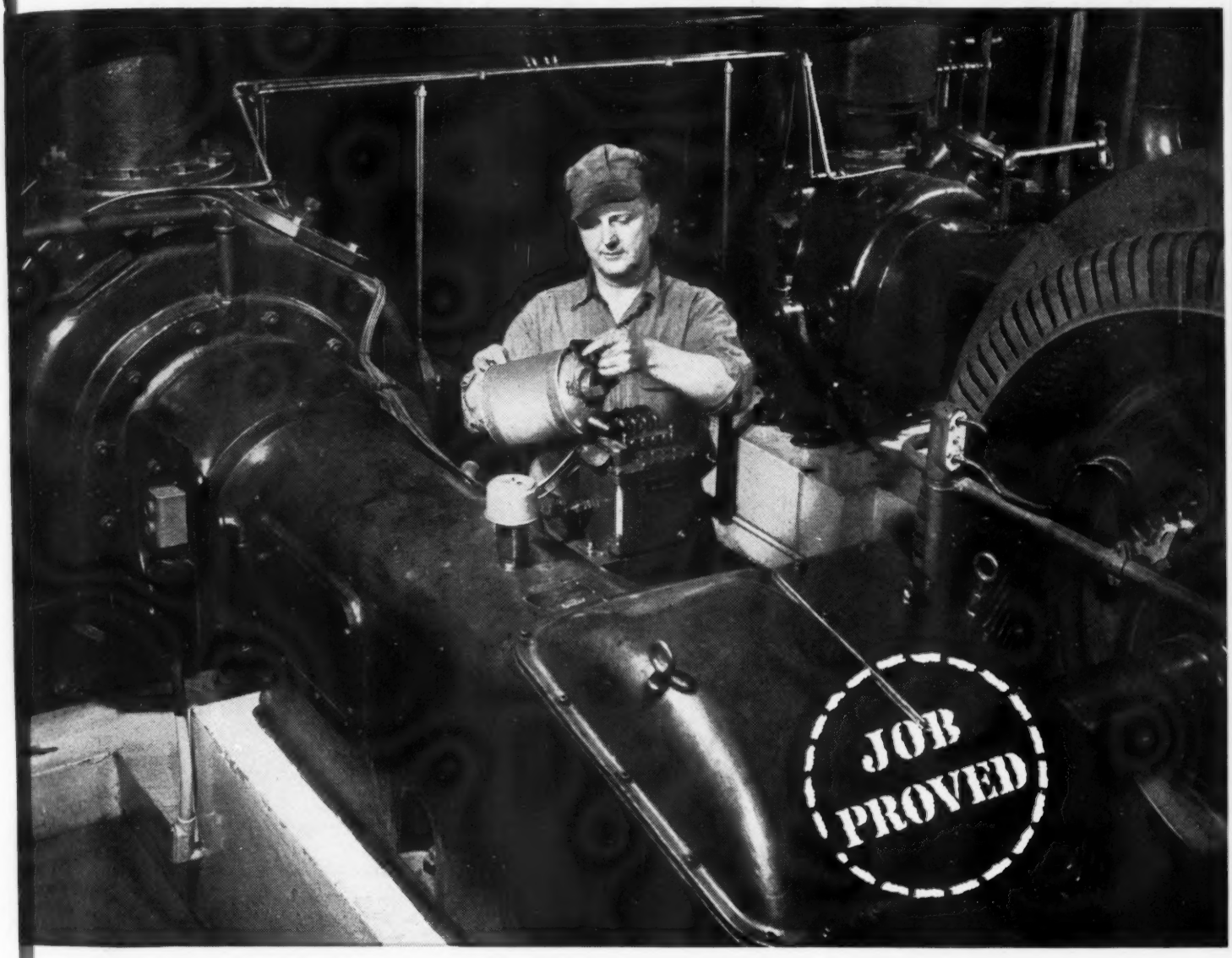






2 To multiply force any machine loses distance proportionately. Here applied force moves 7 times as far as load, so load (neglecting friction) is 7 times applied force. 3 When a beam is supported at 2 points either may be the fulcrum. If right support is fulcrum, 1-ton pull on hoist at 3-ft lever arm supports 3-ton load at 1-ft arm. If chain support is fulcrum, right support at 3 ft must push up 2 tons to support 3-ton load at 2 ft. 4 Bellcrank, with forces acting square to metal arms, has mechanical advantage of 2, so doubles the force applied

Three Years Without a Shut-Down



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Records of this sort are being made every day by "Job Proved" Sun products in hundreds of plants. For lubricants that will give you maximum assurance of steady night-and-day operation, call your nearest Sun office or write Department P-10.

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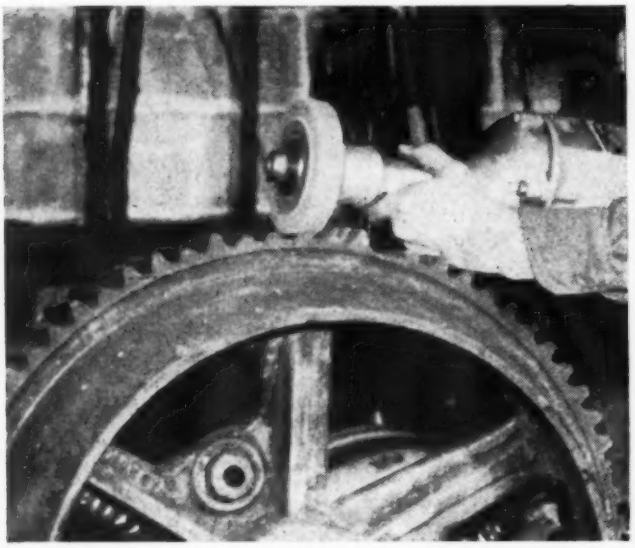
INDUSTRIAL PRODUCTS

HOW TO REBUILD TEETH IN GEAR WHEELS

▶ ONCE ONE GEAR TOOTH breaks it isn't long before they all let go. The absence of one tooth puts greater load and shock on the next until in a short time it also fails. Sometimes important gears are specially built for the job and difficult to obtain quickly, which means a shutdown of considerable duration.

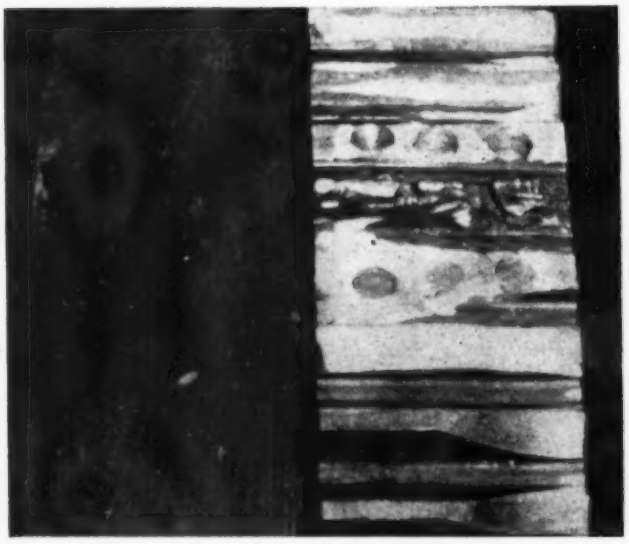
These costly delays in production can be shortened if facilities are available to make the necessary repairs to a damaged part. In the example below the gear was practically rebuilt but the same procedure can be used to restore any number of teeth. Making repairs before the second tooth fails not only shortens the job considerably but also minimizes shutdown time.

Courtesy of Bowers Machine Co Ltd and G D Peters & Co Ltd

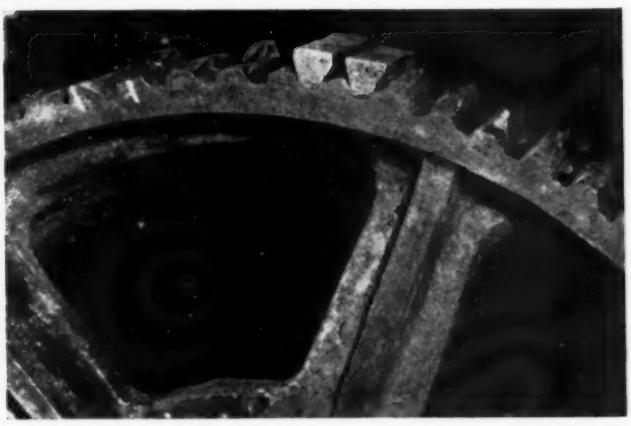


1 Grease can be removed with a brush by immersing the gear in carbon tetrachloride heated to 200 F. Wear protective mask against the fumes. After cleaning, grind off rough surfaces to produce a smooth welding surface.

3 Preheating to 600 F can be done by mounting the gear in an oil-fired furnace so it can be kept hot while welding. Distribute welding heat by making one pass per tooth and rotating the wheel 90 deg to the next tooth.



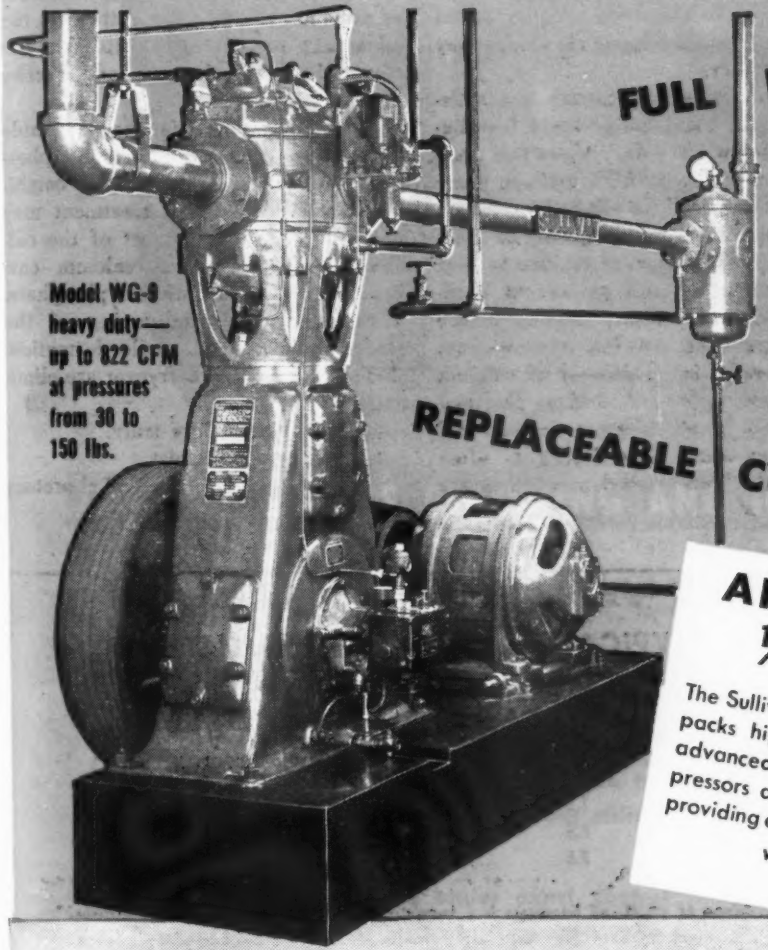
2 When teeth are broken off flush with wheel periphery, drill and tap a series of holes for anchor studs. Screw the studs tightly in place so their free ends protrude far enough to give deposited metal good anchorage.



4 Brass formers can be inserted between teeth to guide the welder in judging the depth of deposit. The nickel-base electrode, especially developed for machinable cast-iron welding, does not adhere to the brass formers.

SAVE FLOOR SPACE

WITH EFFICIENT SULLIVAN COMPRESSORS



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WATER-TREATMENT QUESTION BOX

WHAT IS SELF-PURGING WATER?

By Dr R C ULMER, E F Drew & Co Inc

▶ THIS QUESTION, the fifteenth in a series on water conditioning, comes from the files of Dr R C Ulmer.

Goodwater Laboratory
Drum City, U.S.A.
Dear Chemist:

Workers in the water-treatment field frequently use the term self-purging water. What do they mean?

Your truly,
WALTER TENDER

Dear Walter:

From a chemical and physical standpoint, prevention of boiler scale is well understood. Unfortunately, this does not often appear to be true either because of failure to carry out the recommended preventive measures or because extravagant and unreasonable claims were made for the method used. In brief, here is the explanation.

What happens inside a boiler depends on the particular water concerned. Temporary or carbonate hardness is destroyed by heat or boiling. That is, calcium and magnesium bicarbonate break down to form calcium and magnesium carbonates liberating carbon dioxide. In the presence of alkali the magnesium carbonate is converted to magnesium hydroxide. None of these materials is scale forming although they may cause sludge deposits and carryover. To prevent this, organic materials, especially colloidal types, have been used to good advantage.

If the water also contains permanent or sulphate hardness, sufficient alkali must be present to precipitate it. The alkali may be present as sodium bicarbonate or, if not present, it is added as part of the treatment. Thus the hardness or scale-forming salts are changed into sludges which, although non-scale forming, may still cause adherent sludge deposits and carryover. As mentioned, the organic colloids have been used to good advantage in eliminating these difficulties.

If sufficient alkali is present in the water to precipitate the temporary or permanent hardness, or both, in the desired manner, the water is called *self-purging*. No chemicals need be added although conditioning of the sludge may be necessary.

The described treatments are satisfactory for most low-pressure installations (below 150 psi). Above this pressure, especially at high ratings, some scale may form. To eliminate this, external treatment or phosphate, or both, may be used. When phosphate is used both temporary and permanent hardness are converted to phosphate before any excess of the latter shows up. Therefore, a large amount of calcium phosphate is formed, and as this material may cause adherent deposits and carryover, some conditioning is often required. Two general procedures are common, namely, the use of tannin as a dispersive agent and coagulants such as organic colloids. The latter has the advantage of making possible the removal of suspended matter, and thereby decreasing carryover.

For hard waters it is often desirable to limit the amount of calcium phosphate formed. Consequently, a combination phosphate-alkali treatment may be used. This causes part of the calcium to precipitate as calcium carbonate and part as calcium phosphate. Through proper conditioning of the sludge thus formed, scale formation, sludge deposits and carryover are eliminated.

Yours truly,
Chemist
Goodwater Laboratory

TYPICAL RAW-WATER ANALYSES

Internal Treatment

Sample	*pH*	*P alkalinity*	*M alkalinity*	*H hardness*
1	7.5	0.0	3.8	3.8
2	7.5	0.0	5.9	3.8
3	7.5	0.0	2.9	4.3
4	7.5	0.0	3.4	11.6

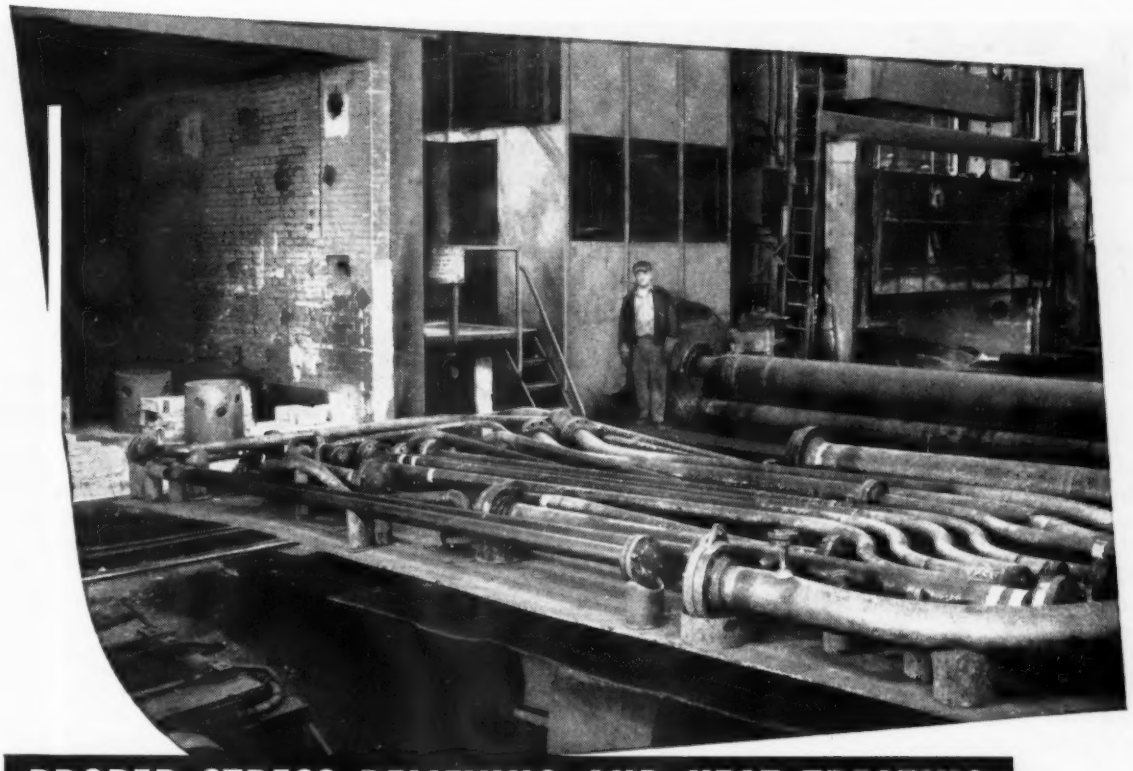
1 Since *M* = *H*, all hardness is a temporary or carbonate type. All hardness is destroyed by heat (self-purging water). Alkali must be added to prevent corrosion. Usually, sludge conditioning is necessary. Phosphate may be required for high pressure.

2 Since *M* is greater than *H*, water is "self-purging" in that all the hardness is destroyed on heating and sufficient alkali is present to prevent corrosion Usually, sludge conditioning is necessary. Phosphate may be required for high pressure.

3 When *M* is less than *H*, sulphate or permanent hardness is present. Alkali or phosphate, or both, must be added to precipitate the hardness. Sludge conditioning is usually necessary.

4 *M* is less than *H*, and *H* is high. Combination alkali—organic—phosphate treatment is often used. Zero hardness, but no excess phosphate, should be maintained. Sludge conditioning is required.

MODERN PRESSURE PIPING REQUIRES SPECIALIZED SHOP FACILITIES AND PERSONNEL



PROPER STRESS RELIEVING AND HEAT TREATING

Demand Furnaces Like These

A really superior job of heat treating and stress relieving requires furnaces like these which handle entire subassemblies. And only qualified pipe fabricators have the experience background for proper utilization of these facilities.

These furnaces are under exact control by elaborate instruments and expert supervision. Pyrometers permit operators to exactly regulate the temperature cycles. This correct heat treating and stress relieving is another way in which qualified pipe fabricators maintain control of quality.

Pre-fabricated piping is better piping because made by piping experts working under ideal conditions. You will find it more economical to erect as all difficult operations have been performed in the shop. It is delivered to the job in a series of subassemblies that are commercially practical, correctly aligned, thoroughly cleaned, shop tested and inspected.

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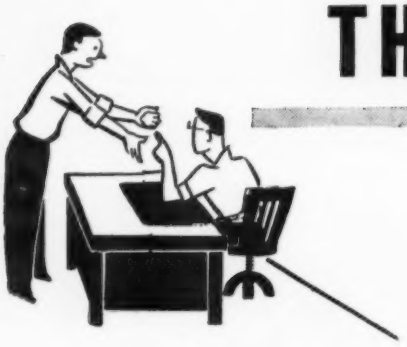
3029-8

THE ARGUMENT CORNER



Here we keep open house for inquiring minds who set the editors straight on such subjects as high-flying minnows, lamp bulbs as fire extinguishers, and the P alkalinity test, not to mention what to do when boiler tubes fail

Remember Those Heaven-Born Fish?

When our own George Edwards ventured the opinion a year ago that a rain of fish from heaven was an amusing but unbelievable myth, L L Scheiderer of Toledo wrote to recall a boyhood experience when tiny fish were lifted from a nearby creek by a small-sized tornado and rained down on the road (Aug 1946, p 150, Power). Now, a year later, Scheiderer sends a front-page story from the *Times* of fishy weather in Toledo. In a downpour 2-inch minnows were rained on the tarpaulin cover of a truck. The sketch below is a cartoonist's adaptation of the reporter's photo. Moreover, the *Times* nature editor stated that while "it is a little out of the ordinary, minnows are sometimes drawn up in a waterspout and then appear to fall from the skies. Thanks, Mr Scheiderer, for keeping us informed about high-flying minnows.

A Point Well Taken Say the Editors

The photograph on the August 1947 cover of Power shows a mechanic using an engineer's wrench on stud nuts. Safety regulations in a plant having equipment this size should require a socket wrench for this work. Let's have fewer injured hands and less time out.

Boston, Mass. Thomas A Ray

What to Do When Boiler Tube Fails

Harry M Spring, in "Meeting Emergencies in Steam Boiler Operation" (Feb 1947, p 108), recommends feeding all water possible to the boiler to maintain water level if a tube or the blowdown fails. I do not believe this solution holds for all conditions. In superheater-tube failure the practice is correct, but for a watertube it is hazardous, particularly in a bank of large boilers such as those in central stations.

I see little value in feeding a large amount of water into a boiler setting. This would flood the furnace, and probably the operating floor and firing aisle with hot water, besides damaging the brickwork. If the tube failure does not kill the fire immediately, it should be pulled as quickly as possible.

After killing the fire, there is little reason to continue feeding water to the boiler. It would be much better to cool the unit slowly than to permit large amounts of water to change the temperature suddenly, causing severe strains and stresses in boiler metals. In the few cases I have known, more damage has resulted from continued water feeding than from tube rupture.

As I see it, when a watertube ruptures, it is usually better for the operator to (1) pull the fire immediately (2) close water and steam valves (3) stop forced-draft fan and (4) secure registers and dampers. If necessary, continue to operate the induced-draft fan to help remove steam, dust, ashes and soot from boiler setting, and to keep fire room as clear as possible. Experience has proved that in large central stations the last operation is important if fire-room crew is to keep other available boilers in service.

San Diego, Calif. A W Shepherd

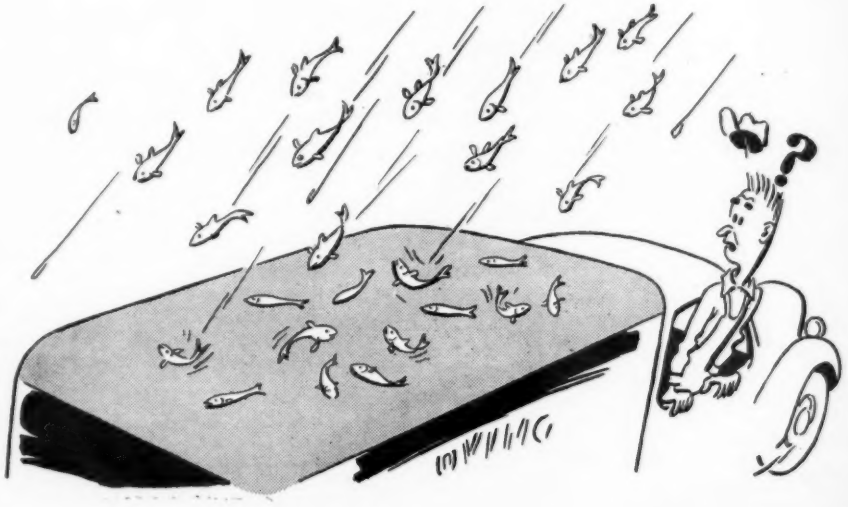
Booster for Guarding Against Over-Optimism

Usually I rate your thinking highly and read your page [George Edwards] in Power with great interest. But in the July issue (p 140) you are sour. You must have written it on one of your off days for I find it hard to believe you looked at the facts and thought through your thesis. I believe your simile is poorly chosen.

We are in a period of high production and high prices. At such times optimistic business men are quite likely to over-extend themselves. Those in frozen foods are an example. They froze a lot of material at high prices. Consumers refused to pay prices that allowed newcomers to the field a profit. I understand quite a few operators in the frozen food field are now out of business.

You and I may not agree with the way the thought is expressed in "Forecast of a recession," but the basic

(*Continued on page* 144)



Is Piping Maintenance Costing More?

OF COURSE IT IS. Shut down and repair costs have increased in the same proportion as other expenses. Copper Tube lines offer greater dollar and cents economy than ever before.

These strong, rustproof corrosion-resistant tubes remain smooth and clean inside. No rusty scale can form to accumulate built-up deposits. As a result, you rarely if ever need to dismantle lines for cleaning. Costs of maintenance and replacement are cut to a minimum . . . and failures caused by rust become a thing of the past.

Reduction or elimination of down time alone can make copper tubes the most economical material to use. For detailed information on Anaconda Copper Tubes and their industrial application, write for Publication C-24.

47H-1

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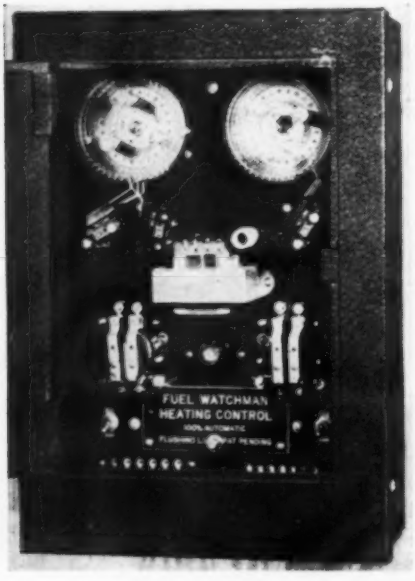
WHAT'S New IN PLANT EQUIPMENT

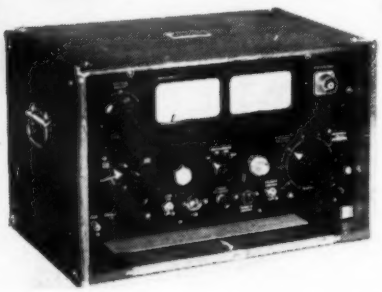


Heating Controller E 37

NEW HEATING-SYSTEM CONTROLLER, called the *Fuel Watchman*, supplies heat as needed for outside weather conditions. Manufacturer says neither open windows nor local sources of heat, ranges, etc, can fool the controller because it does not use room thermostats. Device serves equally well on central or zone control systems, controlling either zone steam or water supply or oil burners, stokers, and gas burners. Once installed and adjusted, the device requires no attention in taking care of heating needs, nightly and seasonal shutdowns, and morning and seasonal startups. Controller consists of (1) roof thermostat (2) series of outside thermostats (3) main control panel. Roof thermostat is located where it receives direct rays from the sun for the greatest length of time. Its purpose is to determine the amount and effect of solar radiation being absorbed by the building and to prevent overheating on mild days.

Six outside thermostats, mounted on the north side of a building where they are protected from the sun, are so adjusted that each operates over a different temperature range. Part of the controller consists of two synchronous motor clocks, one for each outside thermostat. Each disk is notched to correspond to one outside thermostat setting, so that when the outside temperature is 60 F or below, only one schedule is in operation.

With one thermostat calling for heat, its respective clock-driven disk is notched to complete the control circuit at intervals throughout the day. While the circuit is completed the oil or gas burner or stoker operation is controlled by a steam-pressure switch. Morning startup notches keep the control circuit closed until building is warm, after which operation is intermittent. Relays, thermostats, clock motors and transformer are of heavy-duty construction to give long life and trouble-free operation. **Fuel Watchman Co, 77-29 138th St, Flushing, N. Y.**



Insulation Tester E 38

THIS NEW TESTER measures insulation resistance of power cables, transformers, condensers, switches and wiring assemblies at any desired dc voltage up to 10 kv. Breakdown voltage can also be determined with minimum damage because of burning. Two separate circuits measure high resistance at desired test voltage. Full manual control is provided for selecting any output voltage up to the maximum.

Resistances range from 0.1 to 50,000 megohms and may be read directly on a megohmmeter scale at open circuit voltages of 500, 1000, 5000 and 10,000. Megohms may also be simply calculated in ranges from 0.3 to 20,000 megohms from the readings of a voltmeter and microammeter, connected to read resistance at any desired test voltage from 100 to 10,000 v. Either method is selected on one switch. Leakage current ranges are 30, 150, 300 and 1500 microamperes and are readable at any voltage. A polarity reversing switch allows positive or negative side of voltage supply to be grounded. Tester operates from a 115-v 60-cycle system and consumes a maximum of 65 watts. Safety features include a relay that connects the output terminals to a 50,000-ohm 100-watt resistor when power is turned off. This resistor, which removes dangerous capacitance charges remaining on the cable, can also be connected manually by depressing a pushbutton on instrument during test operation. **Radio Frequency Laboratories, Inc, Boonton, N. J.**

Lubricating-Oil Refiner E 39

SMALL AND COMPACT, this refiner makes it possible for industrial plants to re-refine dirty lubricating oil formerly thrown away. Unit refines all lubricating oils, including crankcase drainings from internal-combustion engines. Working automatically, it completely re-refines the dirty oil, removing all impurities in about 20 min. It handles 3½ gal per batch and has a capacity of about 90 gal per 8-hr day. The process uses a specially developed catalyst and a filter. It removes all foreign solids, such as dirt, carbon, sludge, abrasives, and also foreign liquids, such as gasoline, kerosene, sulphuric acid and water.

Automatic oil refiner is 25 in. in dia, 44 in. high, and weighs only 300 lb. It is mounted on casters for easy moving, and operates on 110 or 220 v, 60 cycles. **Holden Co, Buffalo, N. Y.**

Pressure Transmitter E 40

THIS NEW PRESSURE TRANSMITTER has a high accuracy and gives a large electrical ac or dc signal. It is designed for service with various gases and liquids, such as air, oxygen, water, oil, gasoline, alcohol, hydraulic fluids and aniline. In one rugged unit, it combines controlled-action bellows or Bourdon tubes and microtorque potentiometers. Standard units can be supplied in

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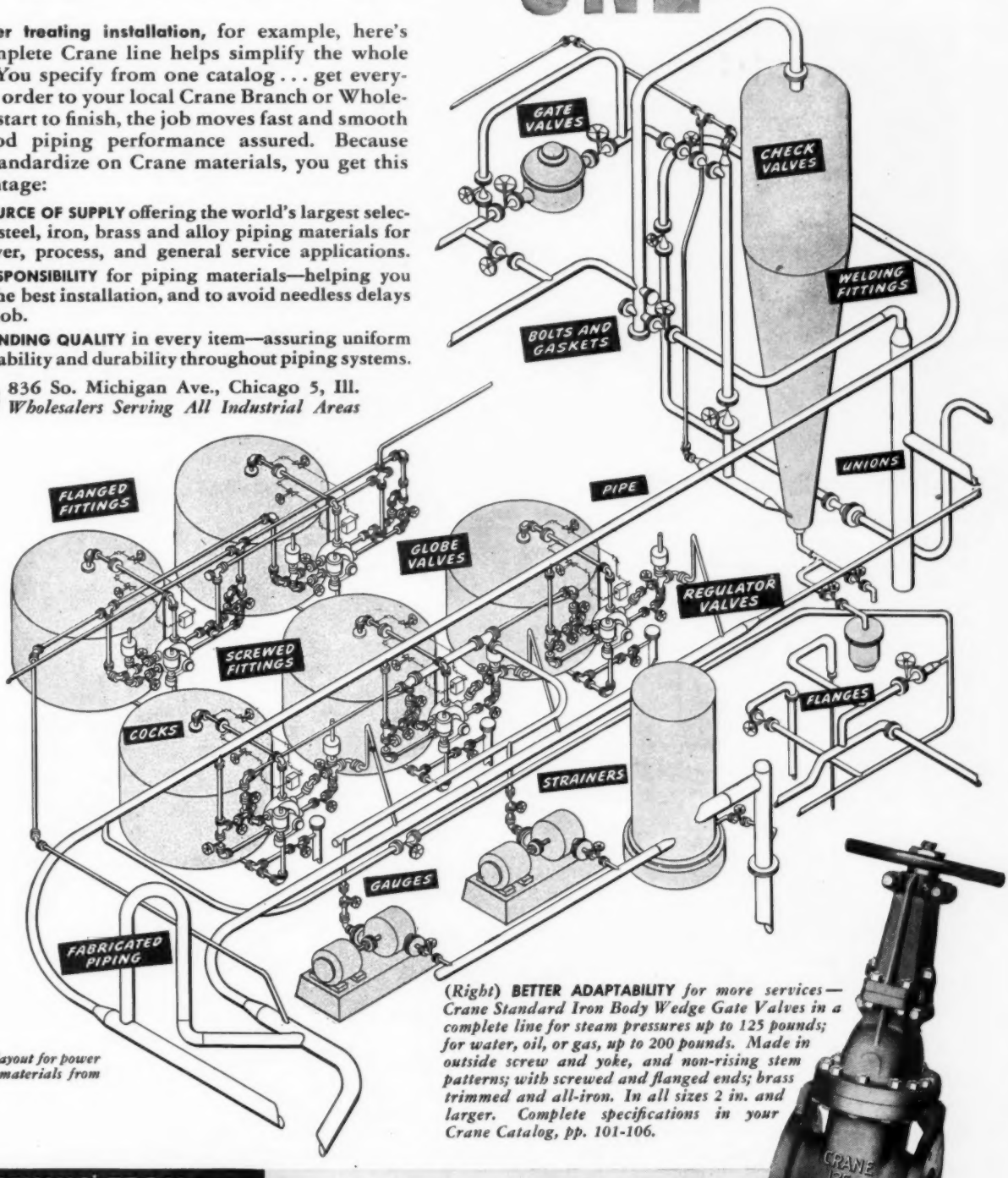
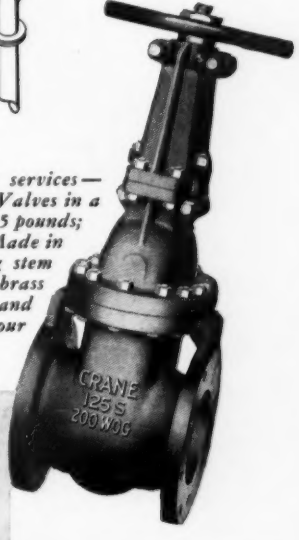


Water treating layout for power plant . . . piping materials from Crane.



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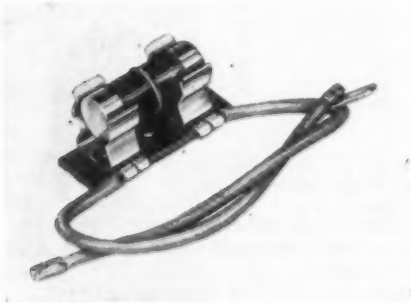
resistances ranging from 100 to 20,000 ohms and 0 to 500 psi, with special ranges on application. **G M Giannini & Co, 285 West Colorado St, Pasadena 1, Calif.**

Tachometer Indicator E41

NEW TACHOMETER INDICATOR, for flush mounting on switchboard, projects only ¾ in. from panel surface on which it is mounted. Indicator is supplied in any one of 50 standard scales covering speeds from 1 to 100,000 rpm. It can serve with any of the Metron tachometer heads for hand or fixed engagement for speed measurement. Panel dimensions are 7½ in. wide and 9¾ in. high with a projection of 4⅜ in. behind front surface of panel. Connections are made to terminals in the rear. **Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.**



Mercury Switches E42

HERMETICALLY SEALED by a patented process of fusing metal to ceramic, these small *Mercontrol* switches are made in 5, 10, 15 and 20 amp sizes and are especially adapted to explosionproof areas. The metal inclosure provides safe and hazard-free operation in atmospheres where switch-sparking constitutes a danger. They provide mercury-to-mercury contact without arcing, pitting or burning. They operate at 110 and 220 v, ac or dc in an ambient temperature of 100 C. Pressure of hydrogen inside switch to quench the arc is 28 psi above atmospheric. Tests prove that these small *Mercontrol* switches will stand an overload of 400% for a short time. Only 1½ in. long, ½ in. in dia, these switches can be installed easily in standard "cartridge-fuse" holders. *Mercontrol* switches are also available in miniature units, 1 in. long, ½ in. in dia. **Mercontrol, Inc, 278 Pearl St, New York 7, N. Y.**

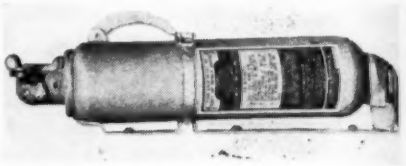
Gage Case E43

ACALOY GAGE CASE is made of a high-compression molded aluminum alloy. Case surface is treated by patented process to prevent corrosion; manufacturer claims it will withstand 1500 hours of salt-spray test. Over the treated surface is a black baked-on finish. A synthetic-rubber sealing gasket and stainless-steel snap ring make the case weatherproof. It can be designed to accommodate safety blowout disks when required. **Helicoid Gage Div, American Chain & Cable Co, Bridgeport, Conn.**

Pressure-Seal Valve E44

DESIGN OF PRESSURE-SEAL VALVE BONNET and body is such that the internal pressure is utilized to make bonnet joint tighter. The small bonnet fits inside body. A circular gasket, placed between body and bonnet, is held in place by bonnet retaining ring, which screws into body. A bonnet clamp is placed on a shoulder in bonnet retaining ring and serves as a bearing for stud nuts.

When bonnet joint is assembled, nuts are tightened, which pulls the bonnet up against gasket. This gives an initial seal between bonnet, gasket and body. As pressure increases within body neck, bonnet is forced against gasket, making joint tighter and eliminating all stress on studs. Total thrust on gasket, created by internal pressure, is resisted by bonnet retaining ring. **Walworth Co, 60 E 42nd St, New York 17, N. Y.**



Fire Extinguisher E45

NEW 4-LB-MODEL DRY-CHEMICAL fire extinguisher, known as the *Ansul* 4, is 19⅛ in. long, 3½ in. in diameter, light in weight, and designed for effective use by inexperienced operators. The extinguisher is suitable for putting out fires in flammable liquids, gases, solids and electrical equipment, and also for controlling fires in ordinary combustibles. Manufacturer says extinguishing agent is nontoxic, noncorrosive, nonabrasive, and a nonconductor of electricity. Device comes supplied with a quick-opening bracket for vertical or horizontal mounting in locations where space is limited. **Fire extinguisher div, Ansul Chemical Co, Marinette, Wis.**

Safety Flashlight E46

APPROVED BY Underwriters' Laboratories, Inc, for Class 1, Group D, hazardous locations, this new *Rub-R-Lite K2* flashlight operates on a new principle. All working parts (including approved bulb-ejector mechanism) are contained in a small sealed-in-head unit that is popped in or out of the steel-lined *Neoprene* case when-

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ever bulb or batteries are to be changed. A specially designed press-on, press-off switch automatically locks in each position. Therefore the light will not turn on accidentally and run down the battery. The pre-focused head unit and batteries become sealed in the *Neoprene* rubber case, which assures longer life. Dropping or throwing does not harm this flashlight because resilience of case permits much abuse. *Neoprene* case resists deterioration from water, oil, gasoline, solvents, non-oxidizing and dilute acids, alkalies and salt solutions. It also withstands sunlight and weather, and resists heat and cold. **Lennan Lights, Inc, 231 W Oliver Ave, Burbank, Calif.**

Control Pilot E47

ALL-PURPOSE PRESSURE-CONTROL PILOT is a simple and positive mechanical device to control action of a diaphragm regulating valve, and thus maintain a constant controlled pressure. Units are available in nine controlled-pressure ranges from ½ to 800 psi. **Leslie Co, 50 Delafield Ave, Lyndhurst, N. J.**

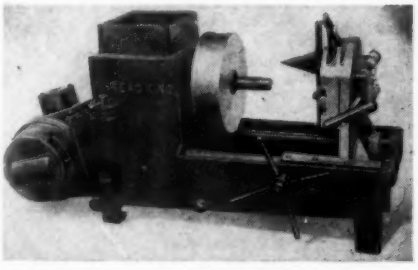
Area Meter E48

ELECTRONICALLY OPERATED AREA METER measures the more viscous liquids, such as black liquor, tar, chemicals, distillates and refrigerants, as well as freer flowing ones, such as water, oil and gasoline. Flow-measuring instrument consists of a specially designed telemetering transmitter connected to a standard Bailey electronic receiver. Like a valve, transmitter is easily installed in the pipeline.

Transmitter has a port area varied by a plug restrained with a calibrating weight or spring. Plug assumes a position proportional to flow rate, which results in a substantially constant pressure drop. Plug is directly connected to soft iron core of telemeter transmitter and any movement of plug causes a voltage ratio variation in telemeter circuit. Electronic receiver employs an impedance bridge measuring circuit that is extremely sensitive to any unbalance in voltage ratio and therefore reacts to slightest movement of plug. Recorder may be calibrated to read in terms of volumetric units, thereby reducing errors because of density changes. Two transmitters may be connected to same recorder to measure the ratio, sum or difference of two flows. **Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.**

Tachometer Head E49

TACHOMETER HEAD for all speed measurements between 100 and 10,000 rpm contains only one rotating part, which is mounted in permanently lubricated ball bearings. Electrical connections are made through ½-in. conduits or fittings to inside terminals. Direct coupling without need of a speed-changing drive is provided for all speed ranges. Dimensions are 2 7/16 x 1 13/16 x 5 in. Operating torque is approximately 1/30 ounce inches. **Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.**



Pipe Threader E50

CONSTRUCTED OF HEAT-TREATED aluminum alloy weighing only 220 lb, the *Thread King* cuts, reams and threads pipe of ¼ to 2 in. dia. Larger sizes up to 8 in. may be handled with a special drive shaft. Pipe sizes are changed instantaneously by a special chuck with a selector dial. By turning dial to required pipe size the one movable clamping jaw gives a positive grip even on short nipples.

A specially designed movable reamer can be easily and quickly lowered into operation. When reaming operation is completed it is backed out and raised clear. The machine uses Armstrong adjustable dies. Three-groove step pulleys give high, medium and low speeds. Where electricity is not available, motor can be removed and base lowered to provide a support for a small gasoline engine. **Century Engrg Co, 5529 S Vermont Ave, Los Angeles 37, Calif.**

Arc Welders E51

NEW AC INDUSTRIAL ARC WELDERS are the moving coil type (both primary and secondary coils move when adjustment is made) with no adjustable magnetic paths. Since one coil moves downward as the other moves upward, weight of descending coil helps lift ascending coil, thus making welding heat adjuster easy to turn.

Current adjustment is made by a convenient knob on a pressed-steel disk that serves as dripproof cover of case. All coils are made of class B glass-insulated copper strap. A ventilating fan draws cool air through louvers at top and expels it at the bottom. A crane or hoist easily handles both stationary and portable types by two lifting eyes on top of case. The welders come in 300 and 500 amp sizes for operation on single-phase 60-cycle current, either 220/440 or 550 v. They can also be furnished for 50 cycles. **Hobart Bros Co, Box 13, Troy, Ohio.**

Balancing Valve E52

RADIANTROL BALANCING VALVE serves in radiant-heating system as a balancing valve to regulate water flow to individual coils in accordance with comfort conditions required in area serviced. *Radiantrol* valve is somewhat similar to a butterfly control valve. It can be used with pipe coils buried as deep as 8 in. below concrete surface because the hollow control stem can be cut to appropriate size. Stem extends from valve to a brass floorplate marked to indicate open or closed position. System is vented

(*Continued on page* 140)

To secure additional information on these new equipment items, use convenient reply cards on page 186A. Please be sure to identify your request with the new equipment key letter and number, as shown on the items above.

Report on Water Treatment Results in Utilities Plants . . .

66.9% of all utilities using the Nalco System of Water Treatment have used it over 5 years!

66.7% of over-5-years Nalco utilities have been getting Nalco chemicals and service over 10 years!

65.8% of the over-10-years group have used the Nalco System over 15 years!

26% of utilities in the over-15-years group have been getting water treatment results with the Nalco System for more than 20 years!

As a user of the Nalco System, the world's finest water treatment laboratories are at your service constantly to handle any special water treatment problems, as well as for routine water analyses to check possible changes in raw water characteristics

There is no better proof of real water treatment service than Nalco's growing list of utilities plants who have been continuous users of the progressive Nalco System over long periods of time.

Permanently satisfactory Nalco Water Treatment results make permanent customers —whether the user is a large utility, or a small plant with low water requirements.

Let Nalco water treatment engineers and chemists take over your water treatment problems now. A Nalco Survey costs you nothing . . . May be your quickest way to permanently effective water treating in your plant.

Write for details today.

NATIONAL ALUMINATE CORPORATION
6222 W. 66th Place, Chicago 38, Illinois
Canadian inquiries should be addressed to Aluminate Chemicals, Ltd. 555 Eastern Avenue, Toronto 8, Ontario

Nalco
The Scientific System of Water Treatment for All Industry

How to plan a

COMPRESSED AIR SYSTEM FOR SOOT BLOWING

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

THE use of compressed air for soot blowing reduces costs and requires less boiler water makeup equipment. A relatively new method of soot blowing, it is used mainly in large boiler installations.

The two stage air compressor in this layout has intercooling as well as aftercooling. It delivers air at 500 psi through the aftercooler and oil separator to storage in a 500 psi receiver. This higher pressure tank supplies a 250 psi receiver through a pressure reducing valve, and the soot blowers operate from the latter tank at full pressure. The higher pressure delivered by the compressor permits the use of smaller storage tanks and reduces the moisture content in the air to be used by the soot blowers. Also, should it be needed, the 500 psi pressure is available for other phases of the blowing operation.

The cooling water circuits are all controlled by Jenkins Fig. 106-A Bronze Globe Valves. The drains are all of the open type to permit a visual check of the flow of cooling water.

Both the oil separator and pressure reducing valve sections are shown in duplicate for standby service, and are provided with O.S. & Y gate valves of the appropriate pressures.

Jenkins PRACTICAL PIPING LAYOUTS 27

Illustrating the proven 3-point formula for trouble-free, time-defying hookups

A **Use the right type valve for the service.**
B **Place valves correctly in the line.**
C **Choose Jenkins Valves for lifetime economy.**

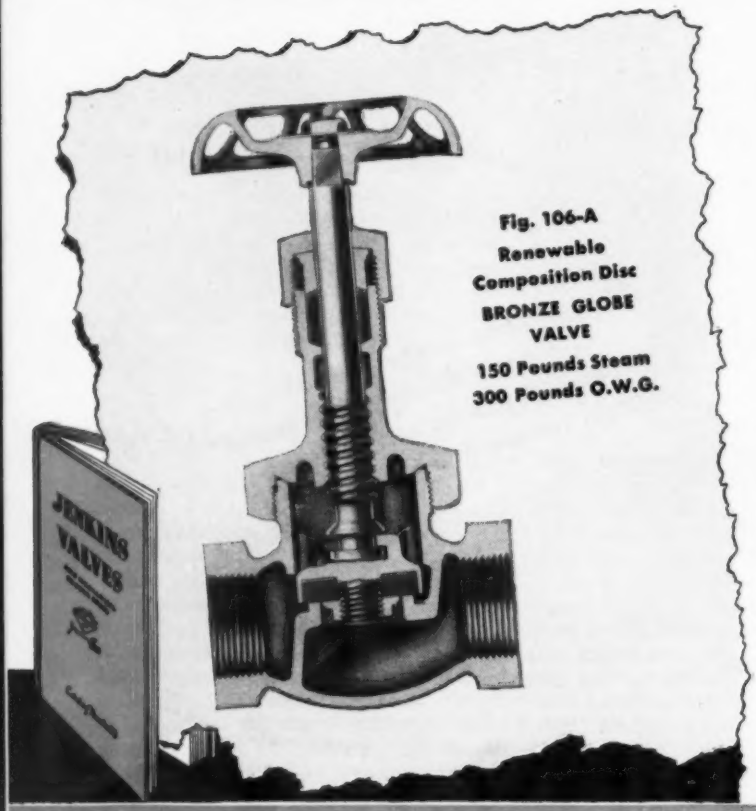


Fig. 106-A
Renewable Composition Disc
BRONZE GLOBE VALVE
150 Pounds Steam
300 Pounds O.W.G.

The intercooler and aftercooler are both provided with traps for removing the condensate, and both receivers are provided with drain valves which must be opened prior to operation of the soot blowers in order to remove all water from the system.

Fig. 106-A, a Renewable Disc Bronze Globe Valve, is designed with a convenient slip-on, stay-on disc holder that permits a quick change of disc. The resilient composition disc assures drop tight closure with the least closing effort. The sturdy screwover bonnet is unaffected by repeated disassembly and reassembly. Many other unusual features, described in Jenkins Catalog, make Fig. 106-A one of the most widely used of all Jenkins Valves.

A CHOICE OF OVER 600 JENKINS VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the Jenkins Catalog. It's your best assurance of *lowest cost in the long run.*

Jenkins Bros., 80 White St., New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago; San Francisco. Jenkins Bros., Ltd., Montreal.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK
SINCE 1864

TRADE JENKINS MARK

125 TO 600 LBS. STEAM PRESSURE

Jenkins Bros

COMPRESSED AIR SYSTEM FOR SOOT BLOWING

Diagram by Huxley Madeheim Consulting Engineer

VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Service
A	1	Fig. 370 Bronze Gate	Cooling Water Shutoff
B	4	Fig. 106-A Bronze Globe	Cooling Water Control
C	3	Fig. 1012 Cast Steel Gate	Shutoff Air from Compressor
D	4	Fig. 1012 Cast Steel Gate	Oil Separator Selection & Shutoff
E	4	Fig. 1012 Cast Steel Gate	Pressure Reducing Valve Selection & Shutoff
F	2	Fig. 282 Bronze Gate	Pressure Reducing Valve Selection & Shutoff
G	2	Fig. 282 Bronze Gate	Main Supply to Boiler Soot Blowers
H	2	Fig. 976 Bronze Globe	Drains
J	2	Fig. 270 Bronze Gate	Removal of Condensate from Intercooler
K	3	Fig. 970 Bronze Globe	Pressure Gage Control
L	1	Fig. 950 Bronze Globe	Trap By-pass
M	2	Fig. 280 Bronze Gate	Trap Shutoff
N	1	Fig. 970 Bronze Globe	Trap By-pass

BRONZE • IRON • STEEL

FOR EVERY INDUSTRIAL, ENGINEERING, MARINE, PLUMBING-HEATING SERVICE

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JENKINS BROS., 80 White St., New York 13, N. Y.

Please send me a reprint of Piping Layout No. 27

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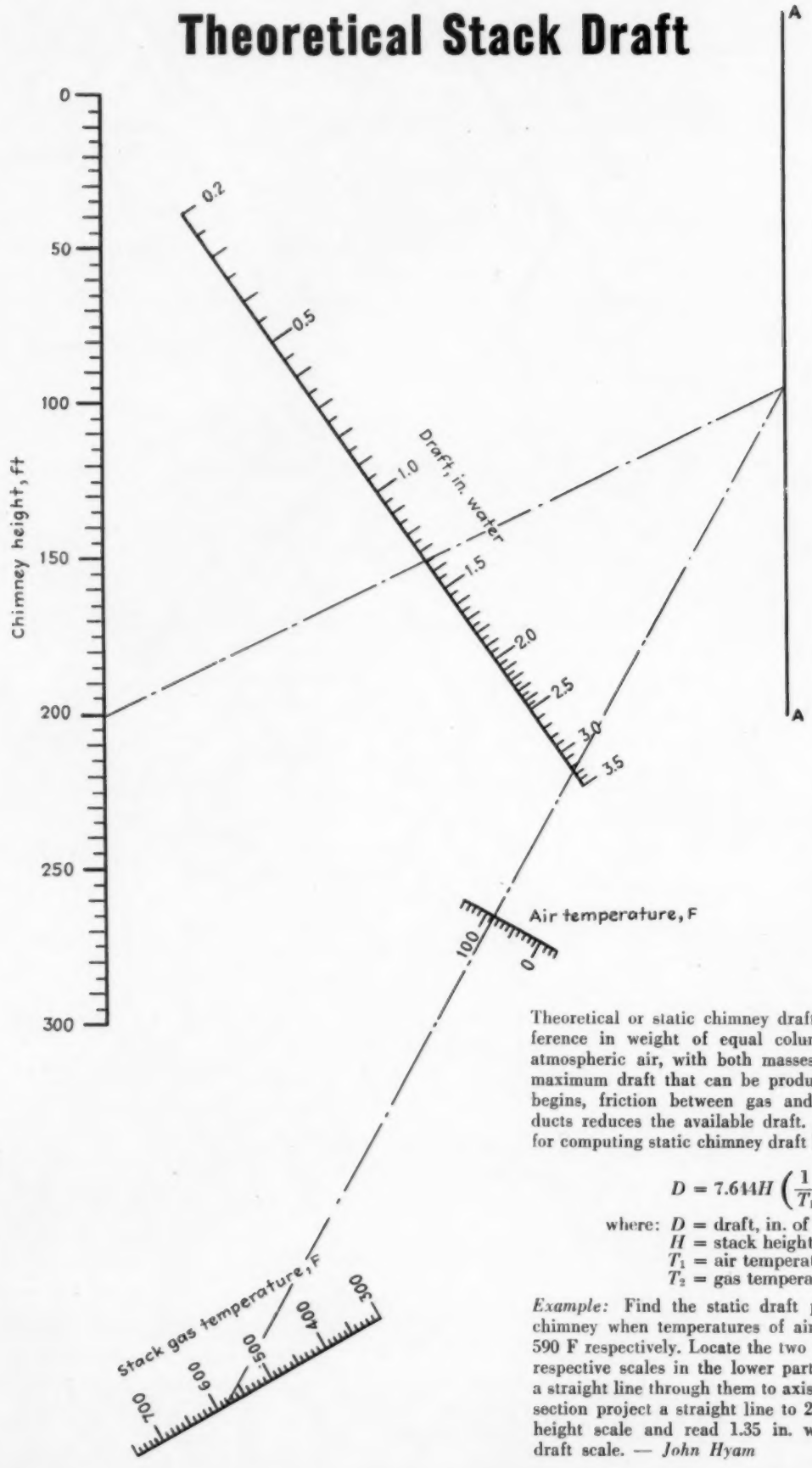
Number 182

Theoretical Stack Draft



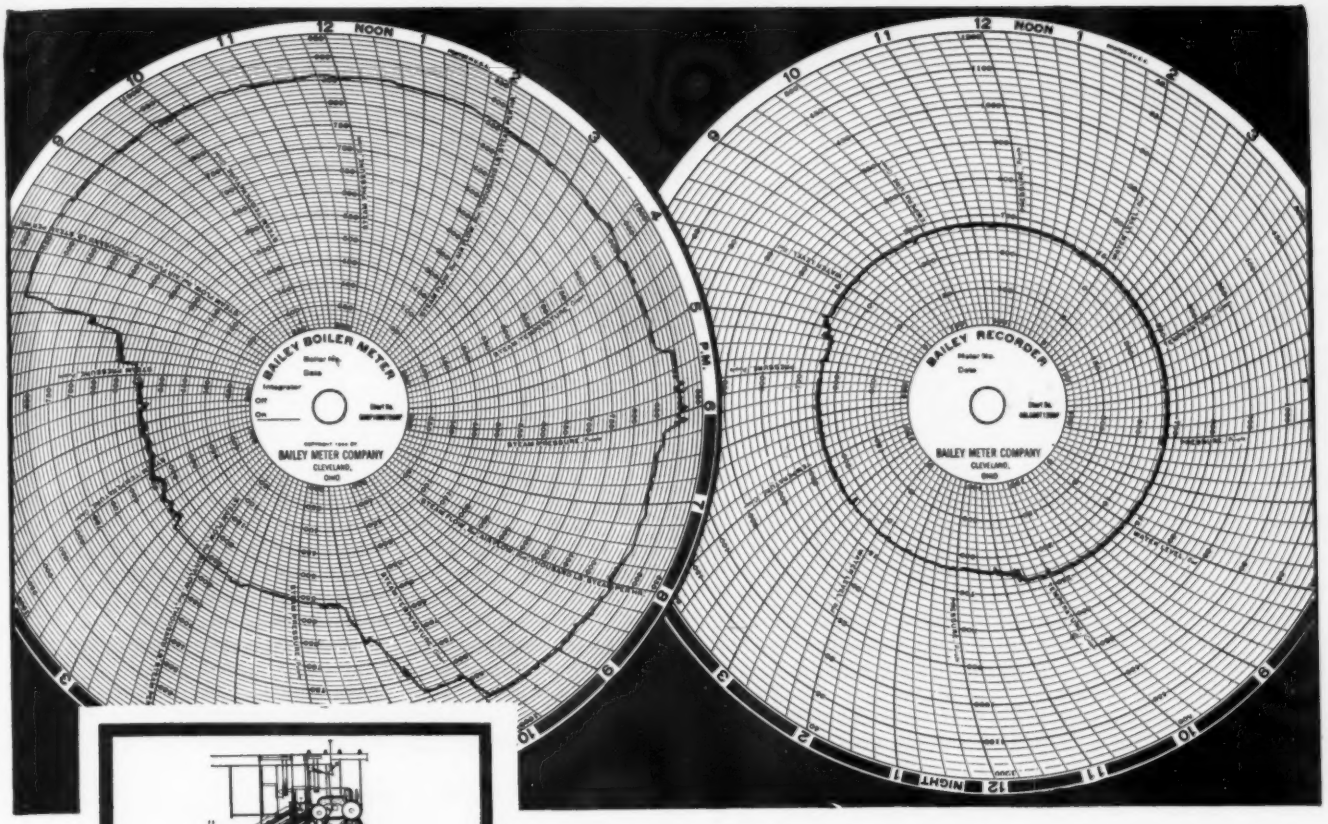
Theoretical or static chimney draft depends on the difference in weight of equal columns of hot gas and atmospheric air, with both masses at rest. This is the maximum draft that can be produced; as soon as flow begins, friction between gas and chimney walls and ducts reduces the available draft. Here is a nomogram for computing static chimney draft based on the formula:

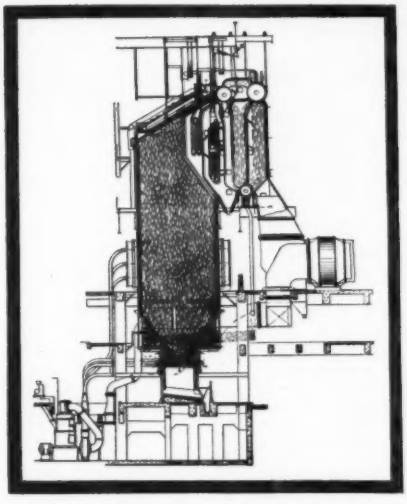
$$D = 7.64HI\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

where: D = draft, in. of water
H = stack height, ft
T_1 = air temperature, F abs
T_2 = gas temperature, F abs

Example: Find the static draft produced by a 200-ft chimney when temperatures of air and gas are 85 and 590 F respectively. Locate the two temperatures on their respective scales in the lower part of chart and project a straight line through them to axis *A-A*. From this intersection project a straight line to 200 ft on the chimney-height scale and read 1.35 in. water on the inclined draft scale. — *John Hyam*

© POWER





875-psi, 900-F C-E boiler designed for 525,000 lb per hr has carried 640,000 lb per hr, yet COPES Flowmatic holds water level within plus-or-minus ½ inch. Write for Report 469 discussing Flowmatic control in three plants of this well-known Southern utility system.

Make boilers safer . . .

No matter how severe your loads, how sensitive your boilers, two-element COPES Flowmatic will give you the dependably close water level control that means safe, efficient operation. Protection against tube failure from low water and carry-over caused by high water is proved by charts like that above, and by more than 2000 installations at pressures up to 1825 psi. Adaptable to any piping layout. For specific recommendations, write in detail about your operating conditions.

NORTHERN EQUIPMENT COMPANY

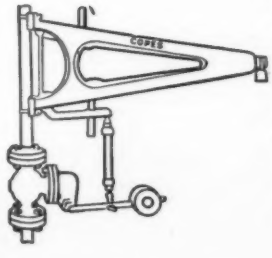
1071 GROVE DRIVE, ERIE, PENNSYLVANIA

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France, Austria

Representatives Everywhere

★ *Get Closer Level Control With The* COPES FLOWMATIC

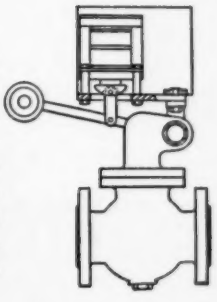


FOR SMALL BOILERS

If you have smaller boilers which carry reasonably constant loads at moderate pressures, you can get all the benefits of continuous feed and stabilized water level from COPES Type OT—a simple level control feed water regulator. Compact, it is easy to install and maintain. A proved performer in hundreds of plants. Write for information.

SOLENOID VALVES

There must be a good reason why important plants have gladly paid a premium for COPES Solenoid Valves. It lies in the sound engineering design, plus the rugged construction which stands up under use and abuse. Not carried in stock, each valve is built for the individual installation. Sizes: ¾ to 6 inch. Write for data.



Engineers Make Leaders

The elder son of a neighbor has just gone off to college. After several months of indecision he chose a course in Mechanical Engineering at one of the Midwestern universities.

Like so many youngsters coming out of high school, he had no conviction about what he wanted to do. Law, engineering, art, business administration, science, politics, economics, agriculture—he looked them all over without favor. And, I guess, it's a pretty fortunate and singular lad of seventeen who has his career picked out.

Invited to give a recommendation, I advised engineering, and here's why. Engineers are in demand today, and will continue to be sought after for several years—so why not take advantage of the market? Many large companies have scouts scouring the engineering colleges, seeking to sign up engineers, and they will be doing this for several Junes to come.

Take the power field, for example. The biggest building program we've ever known is under way—3.5 to 4 million kw of new capacity for the next five years. There will be many young engineers needed to help design, operate and maintain these plants. And it's much the same story for other groups: civil, electrical, aeronautical and so on, all of whom are beginning to feel the push of the atomic age.

Engineering has been a good training ground for many of the country's most important executives, and I'm betting that the percentage will grow steadily. Anything as basic as power engineering, for instance, is bound to give a youngster a sound grasp of business problems, and a pretty clear understanding of relative values.

When you add up both sides of the balance sheet, you'll find that the "engineering outlook" is a valuable thing to have. It means a practical, searching viewpoint—one that is constantly seeking to improve our standard of living by coming up with better, more economical ways of doing things. Yes, I'd like to see whole regiments of bright youngsters take up engineering, for all of us will benefit.

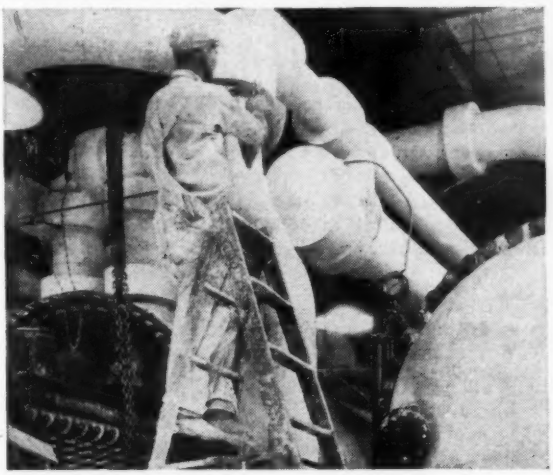
George Edwards

Engineer

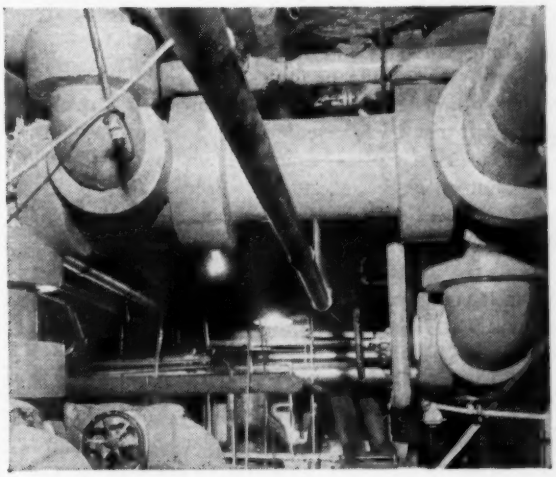
The RIGHT INSULATION, correctly applied, NEVER GROWS OLD

ENGINEERING: In planning your insulation job, first call in an experienced insulation engineer. Johns-Manville . . . Insulation Headquarters for more than 75 years . . . maintains a staff of insulation experts. Each man knows how to take the guesswork out of your job . . . make it "*right* the *first* time."

RIGHT INSULATION: Any insulation will save money—but only the right one will save the most for the longest period of time. Johns-Manville makes a wide range of insulations for every service and temperature. One of them, J-M 85% Magnesia, is the most widely used of all industrial insulating materials.



CORRECT APPLICATION: No insulation is better than the man who installs it. J-M Insulation Applicators are industry's first choice for completely efficient jobs because: (1) They are trained in all phases of insulation application. (2) They employ skilled mechanics and up-to-date application methods.



28 YEARS YOUNG! Back in 1919, J-M 85% Magnesia was installed in the boiler room of the Rice Hotel, Houston . . . engineered right and installed right it is still cutting fuel costs—providing efficient service. Let us help you with your insulation problems. Write Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE *First in* INSULATIONS

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

New High-Energy Pile Uses Plutonium Fuel

► EXISTENCE of a radically new type of atomic pile has been revealed by the Atomic Energy Commission. Successful operation of the new pile, which has been running at Los Alamos since last November, marks an important step toward the solution of several key problems in generation of useful power.

In some respects the new pile is more like an atomic bomb than like previous piles, in that it uses fast neutrons and plutonium, a concentrated man-made "nuclear fuel", instead of the natural uranium used in previous more primitive piles. The new plutonium reactor is at present used to generate heat only. It has so far been operated at a heat output of only a few hundred watts, but the possible output is limited only by the rate at which heat can be removed and the ability of the reactor to withstand high temperature.

In this pile, as in the atomic bomb, the atom-splitting chain reaction is carried on by fast neutrons, but the means of controlling the fast-neutron chain reaction has not been revealed.

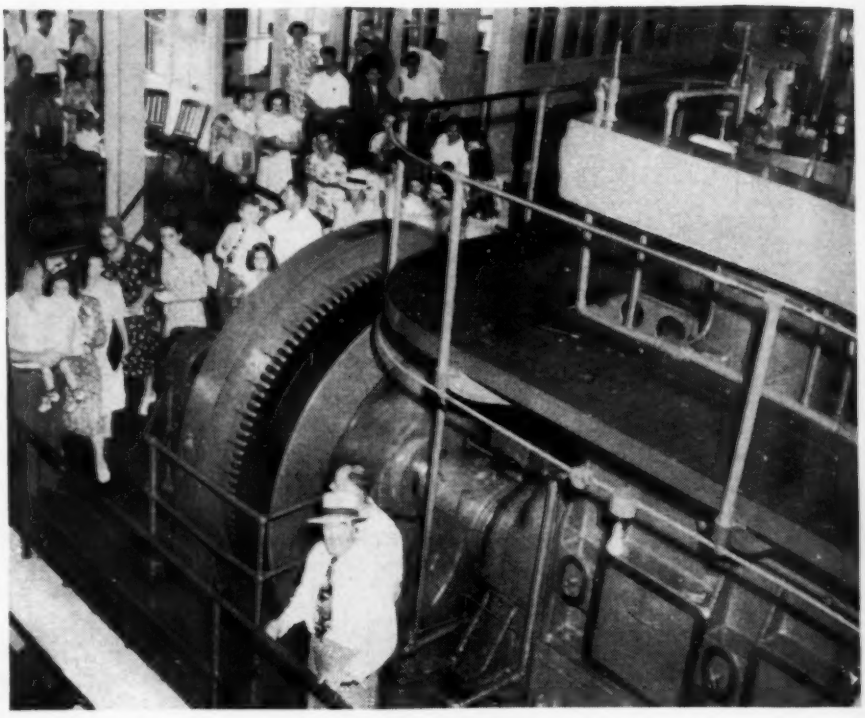
All previous piles operated on a slow-neutron chain reaction not only to permit control of the chain but also to make possible any chain reaction at all. In natural uranium the percentage of the active constituent, U235, is too small to maintain a chain reaction unless artificially stimulated.

By surrounding the slugs of natural uranium (or uranium moderately enriched with U235) with carbon or some other moderator to slow down the flying neutrons, the neutrons were made far more effective in atom splitting, thereby making a chain reaction possible.

These early piles required hundreds of tons of uranium and moderator. The new reactor, it is stated, uses no moderator. Using almost pure plutonium, it requires only a few pounds of nuclear fuel, perhaps of the order of the charge of an atomic bomb.

Presumably the new pile was installed at Los Alamos, the atom bomb center, primarily for an investigation of

(*Continued on page* 182)



Open House at Hudson Plant

Citizens and guests of Hudson, Mass., visited Cherry St generating station of municipal light and power dept on Aug 10. The 50th anniversary of the plant was celebrated by a 3-hour open house. The station interior, containing five diesel-electric generating units totaling 5525 kw, of which a 2000-kw Busch-Sulzer machine, with Westinghouse generator, is the largest, attracted widespread interest. The other units include a 1000-kw Alco-Sulzer machine and three American Locomotive diesels, all four driving General Electric generators

COMING EVENTS

Oct. 16-17—National Conference on Industrial Hydraulics, third annual meeting, Hotel Continental, Chicago. Dr V L Streeter, Armour Research Foundation, Technology Center, Chicago 16, Ill.

Oct 19-24—American Welding Society, annual meeting, Sherman Hotel, Chicago, Ill. M M Kelly, secretary, 33 W 39th St, New York 18, N. Y.

Oct 20-22—American Society of Mechanical Engineers, fuels div meeting, Hotel Gibson, Cincinnati, Ohio. O B Schier, 29 W 39th St, New York 18.

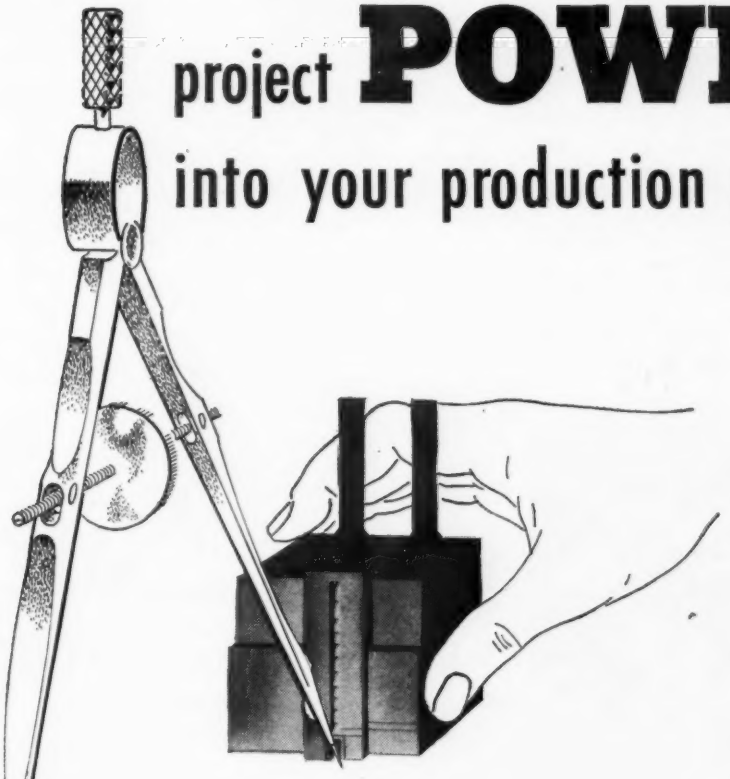
Oct. 23-24—Prime Movers Committee, Pennsylvania Electric Assn, fall meeting, Benjamin Franklin Hotel, Philadelphia, Pa. R L Hallman, chairman, Pennsylvania Power & Light Co, Hazleton, Pa.

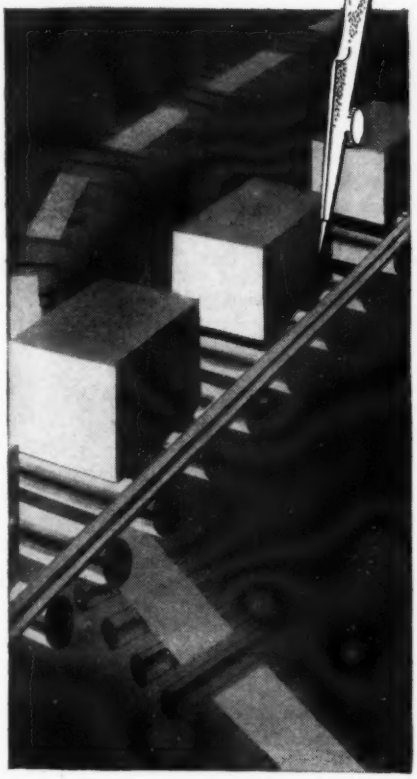
Nov 3-7—American Institute of Electrical Engineers, Midwest meeting, Congress Hotel, Chicago, Ill. H H Henline, 33 W 39th St, New York 18.

Nov 12-14—Engineers' Society of Western Pennsylvania, 8th annual water conference, William Penn Hotel, Pittsburgh, Pa. H M Olson, general chairman, Ohio Salt Co, Pittsburgh.

Dec 1-5—American Society of Mechanical Engineers, annual meeting, Chalfonte and Haddon Hall Hotels, Atlantic City, N. J. Ernest Hartford, executive assistant secretary, 29 W 39th St, New York 18, N. Y.

project POWER into your production planning





Since modern production planning requires projection of a program over a long period of time it's quite logical that power requirements will be based on a similar long-range study of peak demands for all of the industrial services supplied by modern boiler and power plants.

Because power plant construction, expansion, or modernization does require advance planning *after* your Consulting Engineers have completed their specifications and detail drawings, it's never too early to call in Dravo Power Plant Specialists. When you draw upon Dravo experience during prior planning you can be assured that power and boiler plant construction will be completely integrated with the over-all project—you can schedule your future power requirements and depend upon Dravo to maintain the construction pace to meet those schedules.

There are important advantages to be gained when Dravo contract methods and construction techniques are applied to your power or boiler plant projects. Additional details of these methods and techniques are reviewed in Bulletin DR-504.

DRAVO

DRAVO CORPORATION

PITTSBURGH • PHILADELPHIA • CLEVELAND • NEW YORK
ATLANTA • DETROIT • WILMINGTON

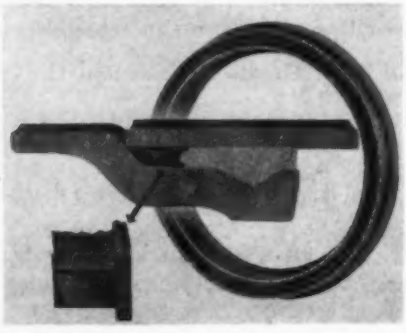
Power and Boiler Plants • Pumping Stations • Power Plant and Contractors' Equipment • Direct-Fired Heaters
Industrial Heating and Ventilating • Bridge Substructures • Docks • Pump Houses and Intakes • Mill Foundations
Locks and Dams • Shafts, Slopes and Tunnels • Towboats and Barges • Coal and Ore Bridges • Cranes and
Derrick Boats • Crane Cab Coolers • Open Steel Flooring • Concrete Aggregates • Inland River Transportation

by removing floorplate and hollow stem and turning a small capscrew on top of valve bonnet, which is drilled to permit escape of air from piping system.

Radiantrol valve comes in 1¼-in. size, which is adaptable to 1 and 1½-in. pipe. Fiber container in which valve is shipped is designed so that it can serve as a concrete pouring form. **Homestead Valve Mfg Co, Coraopolis, Pa.**

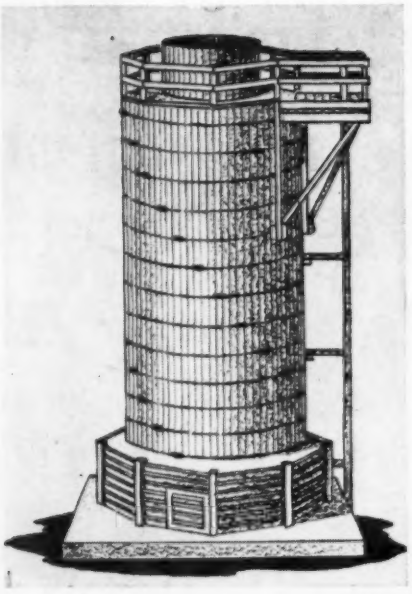
Flexible Metal Hose E53

SEAMLESS FLEXIBLE METAL HOSE is made of a bronze tube formed into a uniform helically corrugated, flexible hose. To give additional safety, extra life and prevent elongation, hose is incased in a bronze wire braid. Sheath is permanently attached to couplings to relieve the hose itself of damaging strains. The *Uniflex* fitting provides metal-to-metal seat by a seal produced between fitting body and spring washer effect of hose itself. No brazing or packing is required. **Brockway Co, Naugatuck, Conn.**



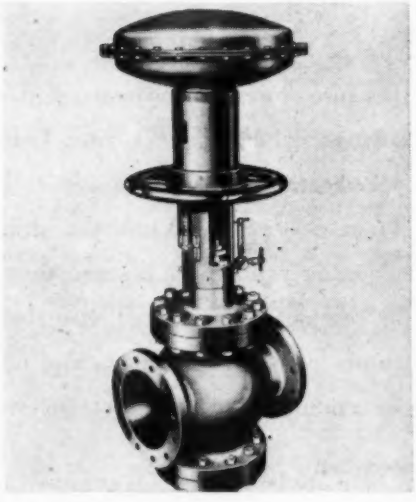
Pipe Packing E54

SELF-ADJUSTING, SELF-LOCKING rubber-ring packing for bell and spigot cast-iron pipe joints can be used with any joint compound. Without compound, the ring holds 40- to 60-psi pressure. **Smith-Blair Inc, South San Francisco, Calif.**



Cooling Tower E55

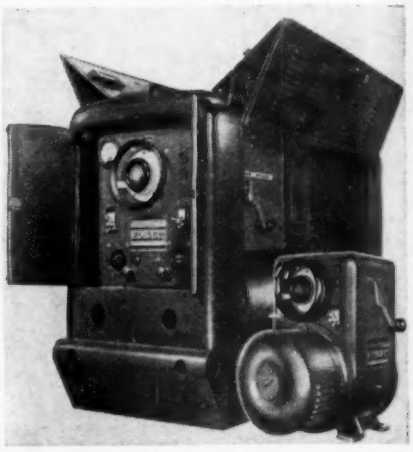
CYLINDRICAL COOLING TOWER can be built of wood or steel in either individual or multiple cell units and with single or double wall construction. Design allows air to enter the tower from any point of the entire 360-deg circumference. **Santa Fe Tank & Tower Co, 5401 S Boyle Ave, Los Angeles 11, Calif.**



Diaphragm Valve E56

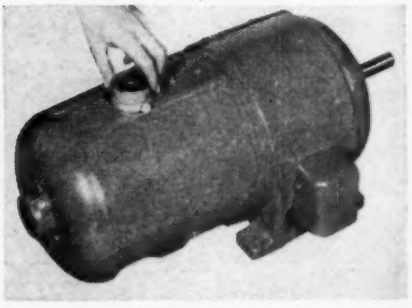
NEW DIAPHRAGM CONTROL VALVE is fitted with a continuously connected handwheel that permits manual operation if operating pressure fails or the control instrument, for any reason, fails in operation. Valve is positioned by merely turning handwheel. Manufacturer claims that valve eliminates necessity of a conventional bypass. Travel limit stops are incorporated that can be set to limit valve stroke from 0 to 100%. They can be set to permit a 25% valve travel at any point in valve stroke from fully closed to fully opened. Then if operating pressure fails, the control valve plug could only change its position plus or minus 12½%.

A position indicator automatically indicates valve plug position and shows setting of travel stops. It shows percent of free travel of valve plug, and in exactly what portion of valve stroke the free travel can occur. It also reveals whether handwheel is in a neutral position. **Hammel-Dahl Co, 243 Richmond St, Providence 3, R. I.**



Welder, Power Unit E57

NEW 200-AMP rotary ac arc welder for construction, maintenance and repair welding, includes a simply operated changeover switch to convert the welder generator into a 52-amp 120-v 60-cycle 5-kw 6.3-kva single-phase power unit. Model *GA* is complete with gasoline engine drive. Model *WA* is arranged for local power attachment. **Hobart Bros Co, Troy, Ohio.**



Adjustable-Speed Motor E58

AVAILABLE IN RATINGS from 3 to 50 hp, 220, 440, and 550 v, the new *Tri-Clad* motor features stepless speed adjustment over a 3 to 1 ratio by simply turning a dial. The entire unit, with the exception of starter control, is self-contained in a housing a little larger than that for constant-speed motor of comparable rating.

(*Continued on page* 166)

To secure additional information on these new equipment items, use convenient reply cards on page 186A. Please be sure to identify your request with the new equipment key letter and number, as shown on the items above.

Achilles Heel

...INDUSTRIALLY SPEAKING

Legend tells of the supposedly indestructible Achilles and how finally he was slain when an arrow found its mark in his only vulnerable spot—his heel.

Too often in industry today, Production's vulnerable spot is the boiler plant . . . a boiler plant made unprofitable by improper water conditioning.

Correct water conditioning is a matter of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Our staff of engineers will welcome the opportunity of discussing your boiler water problems . . .

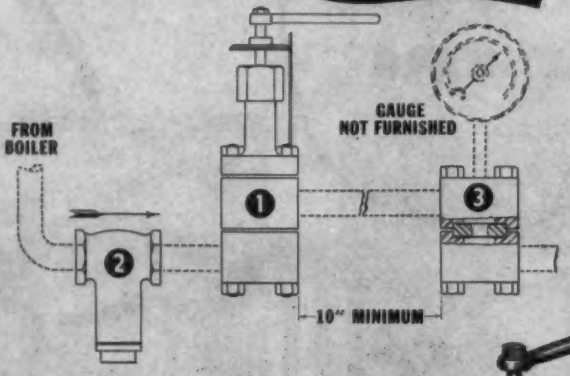
W. H. & L. D. BETZ, Gillingham and Worth Sts., Philadelphia 24, Pa.

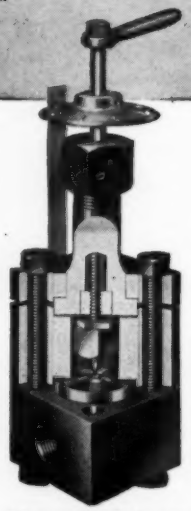
In Canada: Betz Laboratories, Limited, Montreal 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

Custom-Built... CONTINUOUS BLOWDOWN





Also available in outside screw and yoke.

STRONG Dual-Orifice Assembly gives Greater Accuracy . . . Rugged Service!

Strong's Continuous Boiler Blowdown Assembly includes a Strong *block steel* Evrtyte* Valve (1), a strainer (2) and an orifice block (3), *custom-built* and accurately sized for *your own job conditions.*

The assembly is essentially two orifices arranged in series. The first orifice (valve) is variable . . . . the second is fixed. Correct proportioning of orifices provides extremely accurate control and reduces wire drawing.

Strong Evrtyte steel valves have special Anum-Metl X† seats and discs of 750 Brinell surface hardness for long life. Available for pressures to 1500 psi and temperatures to 800° F. or 6000 psi non-shock cold service.

Let us custom-size your continuous blowdown system. Send for Catalog No. 102 and our Continuous Blowdown Check-Chart today!

* Reg Trade Mark

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

† ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve | No. 80 Series Trap | Strainer

STRONG

Pump Q and A

(*Continued from page* 116)

Q 15—What determines the kind of material in rotary pump construction?

A—Rotary pumps are manufactured of almost all common metals and alloys depending upon the service the pump is intended for. For fuel-oil and lubricating-oil service, casing and rotors are usually cast iron, and the shafts carbon steel. Corrosive liquids require special metals such as bronze, monel, inconel, nickel and various stainless steels.

Abrasives wear the closely fitted parts of rotary pumps. If considerable abrasive material is present in the liquid, rotary pumps are not recommended.

Q 16—What is meant by pump fittings?

A—A rotary pump is classified as iron fitted if all parts in contact with the liquid are iron or steel. Likewise, for a steel or bronze rotary pump all parts in contact with the liquid are steel or bronze.

The terms, bronze fitted and standard fitted, are at present rather vague when applied to rotary pumps because of the many types and the different ideas of manufacturers. Usually these terms apply to pumps with iron casings and some bronze operating parts.

Q 17—What precautions must be taken when designing and applying rotary pumps made in stainless steel?

A—Stainless-steel parts have a serious tendency to gall or seize if rubbed against one another. It is necessary to select stainless steels of different structure and hardness for all parts in rubbing contact within a rotary pump. Stainless rotary pumps are usually not recommended for low-viscosity liquids that do not have sufficient body to prevent metal-to-metal contact.

Q 18—Why do rotary pumps seldom have plastic and rubber parts?

A—The rotating elements must operate with only a few thousandths of an inch clearance in the casing. Many liquids cause plastics and rubbers to swell enough to jam the operating parts. These materials are therefore, usually limited to thin parts, such as vanes or wearing plates where the growth of such parts does not affect pump operation.

Q 19—What precautions must be taken in selecting materials for rotary pumps that operate at high temperatures?

Power Engineers Agree: It's the GUTS that make a GOOD BOILER

STEAMASTER Builds Boilers with PLENTY of GUTS!

In design, construction and materials, Steamaster builds boilers with the guts to give reliable, efficient performance year in and year out.

Completely Shop Assembled

The GUTS of the Steamaster Boiler

Water Tube Design

Inclined Tubes

Sectional Steel Headers

Longitudinal Drum

In every industry where high pressure boilers are used you will find Steamaster Automatic Boilers giving consistently excellent performance at low cost.

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AUTOMATIC BOILER CO.
Compton at Slauson Ave., Los Angeles 11
SALES AND SERVICE IN ALL PRINCIPAL CITIES

Quick Facts About the Advantages of the STEAMASTER Water Tube Boiler:

- **All Steel Construction.**
- **Positive Tidal Circulation of Water**—maintains all parts at equal temperature.
- **Condensate Return System Built-in** as an integral part of all boilers of 60 h.p. and up.
- **Fabricated Entirely in Our Own Plant.**
- **Easy Inspection and Maintenance**—every tube immediately accessible. Just open the heavily insulated access doors.
- **Large Combustion Area . . . Three-Pass Heat Baffling** gives high thermal efficiency.
- **Choice of Fuel — Gas, Oil or Coal** or any combination of these fuels to meet fuel requirements of your plant.
- **Fully Equipped for Automatic Operation**—with the finest accessories. As nearly automatic as a boiler can be.
- **A.S.M.E. CODE — National Board Approved.** Inspected and certified by Hartford Steam Boiler Inspection and Insurance Co.
- **Full Range of Sizes** from 10 h.p. to 300 h.p. as illustrated. The Model A for 3½ h.p., 5 h.p. and 7½ h.p.
- **Can Be Fired Over Rated Capacity** and still maintain high thermal efficiency.

Power Engineers Agree: STEAMASTER is the Boiler with PLENTY OF GUTS!

THERE is a wealth of practical, up-to-date factual information about expansion joints and flexible connectors packed into this *new* 60-page catalog compiled by the technical staff of Zallea Brothers & Johnson.

For instance, twenty double-pages offer specific, usable data on the many types of Zallea expansion joints. There's a full description of the manufacturing process for every expansion joint that includes welding and forming, annealing, pickling and passivating.

In addition you'll find detailed discussions on how to select the proper expansion joint for each specific application and the advantages of each, *plus* many charts and diagrams. Also, it's profusely illustrated with photographs of actual applications.

Never before has such a complete, comprehensive catalog been published on expansion joints and flexible connectors *exclusively.* Catalog 47 is *FREE* . . . a request on your company letterhead will bring it to you. Use it as a guide or as a permanent reference source. And when unusual conditions confront you, ask for the assistance of our technical specialists. *Zallea Brothers & Johnson, 814 Locust Street, Wilmington 99, Del.*

Zallea
EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

A—Materials in the rotating elements must not have a higher coefficient of expansion than the casing material. Bronze parts, for instance, expand faster than iron or steel and often this expansion at moderately high temperatures is enough to jam the closely fitted parts of a rotary pump. Most rotary pump manufacturers recommend steel casings for temperatures above 450 F, because cast iron is liable to crack if suddenly chilled above this temperature.

Q 20—What kinds of seals are used on rotary pumps to prevent leakage along the shaft?

A—Adjustable gland-packed stuffing boxes are commonest on rotary pumps. These are supplied with lantern gland seal rings for packing lubrication or pressure breakdown when required. Some rotary pump manufacturers provide spring-loaded stuffing boxes for automatic packing adjustment. Mechanical seals are in common use on rotary pumps to prevent leakage of a wide variety of liquids.

Q 21—What liquids do rotary pumps generally handle?

A—They pump practically all liquids that do not contain solid matter to abrade or clog, also liquids that do not corrode. These vary in viscosity from gasoline and water to oils, paints, varnishes, viscose, asphalts, molasses, soaps and greases.

Argument Corner

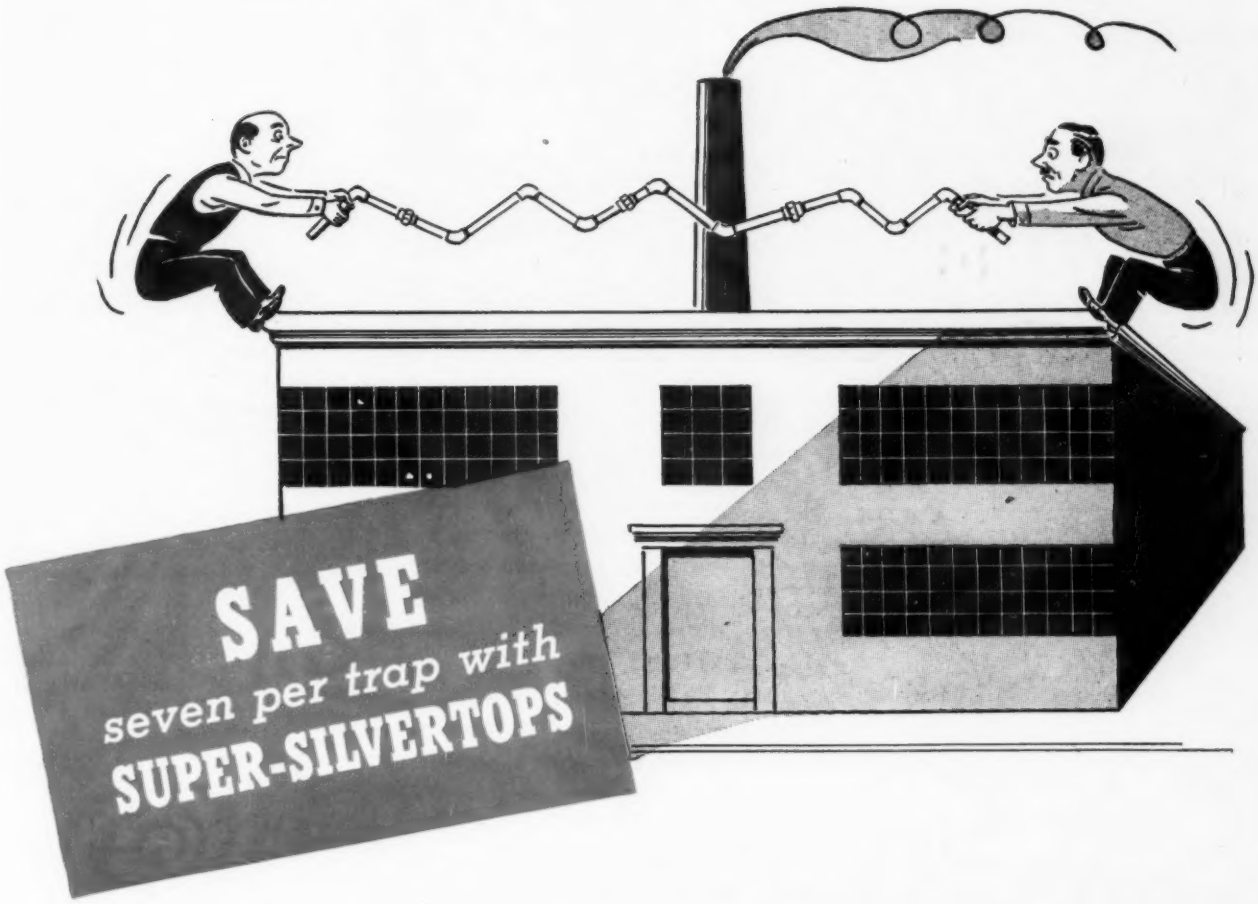
(*Continued from page* 124)

thought is of value. I believe the economic expert is trying to say to his reader: "Open your eyes, examine the position of your business. Production in some lines is out of balance. Prices in some lines are too high for the consumer to take all that is being produced. Take care that you are producing goods at a cost you will be able to realize."

Would you berate a boiler inspector for telling the owner of a boiler plant that he must keep scale out of his boiler or suffer a financial loss? Would you remove safety men from plants because they tell workers that they must think about what they are doing and do their job in a way to avoid accident rather than encourage accident or injury?

A simile better representing the writer of "Forecast of a recession" might be a man standing near the door of a theater expecting a capacity crowd, saying: "There is a danger of fire to-

S-t-r-e-t-c-h *those scarce fittings*



● You can stretch a small supply of fittings—scarce fittings—to cover more of the needs of your plant when you use Super-Silvertop Steam Traps. Super-Silvertop Steam Traps have the U-tube built-in, and you save all the fittings otherwise needed to form that U-tube. The savings often amount to as many as nine fittings per trap installed, to say nothing of installation time (up to 60 minutes for each trap.) You make this saving with every size of Super-Silvertop, including the big No. 25 trap and also on the higher pressure steel series traps.

Stretch-out those scarce fittings—make them go farther—use Super-Silvertops and simplified piping. For all the facts and details send for your free copy of "How To Choose A Steam Trap," free on request.

THE V. D. ANDERSON COMPANY
1950 WEST 96th STREET • CLEVELAND 2, OHIO

and here's how

Super-Silvertop showing one nipple and one union needed.

Conventional trap using seven fittings and two unions.

SUPER-SILVERTOP
STEAM TRAPS

HELICOID SCORES AGAIN!

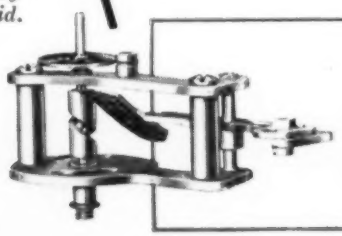
• The new ACALOY case is a high-compression molded aluminum alloy. Treated by a patented process to prevent corrosion. Durable baked-on finish. Withstands 1200 hours salt spray test.

Weather-proof. Neoprene sealing gasket. 18-8 stainless steel snap ring. Greater strength—less weight. It's another Helicoid exclusive.

With back flange for wall mounting, or without flange for stem mounting. Safety blow-out discs optional.

Specify Helicoid gages in the new ACALOY case. They will reduce your maintenance expense. . . . the Helicoid movement, with no gear teeth to wear out, lasts many times longer.

Send for the new catalog that tells the complete story of Helicoid.



Only Helicoid pressure gages have the Helicoid movement.

ACCO

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut

TRADE MARK

night. Be sure to locate the fire exits. In case of an alarm you will know how to get out quickly."

Pacific Grove, Calif. A M Cox
Chemical Engineer

EDITOR'S NOTE: Mr Cox' stand is well taken, and we can't find too much to disagree with. The purpose of George Edward's article was to try to stem the flood of gloomy prophesies that we have had from some economic experts.

Lamp Bulbs Don't Make Good Fire Extinguishers

IN MARCH "Practical Aids," p 110, C R Cummings suggests fire-fighting bombs made from lamp bulbs filled with carbon tetrachloride. This old and outmoded device is often adopted in small plants. At one time bulbs were also filled with water and used as hand bombs. In another application, bulbs were filled with carbon tetrachloride and hung by strings at various locatons. When fire charred the string, the bulb dropped to extinguish it.

The hand bomb filled with carbon tetrachloride was discarded for its many objectionable features:

1. Carbon tetrachloride has advantages on certain types of fires, but it may be misapplied. It is not an approved extinguisher and, therefore, not accepted by fire-insurance companies and fire underwriters. Its installation will not reduce insurance premiums. In fact, it is not the answer to the fire underwriter's prayer for a universal extinguisher.

2. As a hand bomb, its effectiveness depends upon the skill of the person tossing it. In the heat and excitement of a fire who has good aim?

3. Often the glass bulb does not break when tossed, but shortly thereafter may explode and spread the fire. In the explosion, flying glass may injure the person who tossed the bomb.

4. The bomb may be used indiscriminately. It might be unintentionally tossed on a fire where it should not be used.

5. Carbon-tetrachloride fumes are poisonous and therefore a health and safety hazard even when the bombs are being made. The fumes should not be inhaled. They can be fatal to a novice, with no knowledge of their potency and toxic effect.

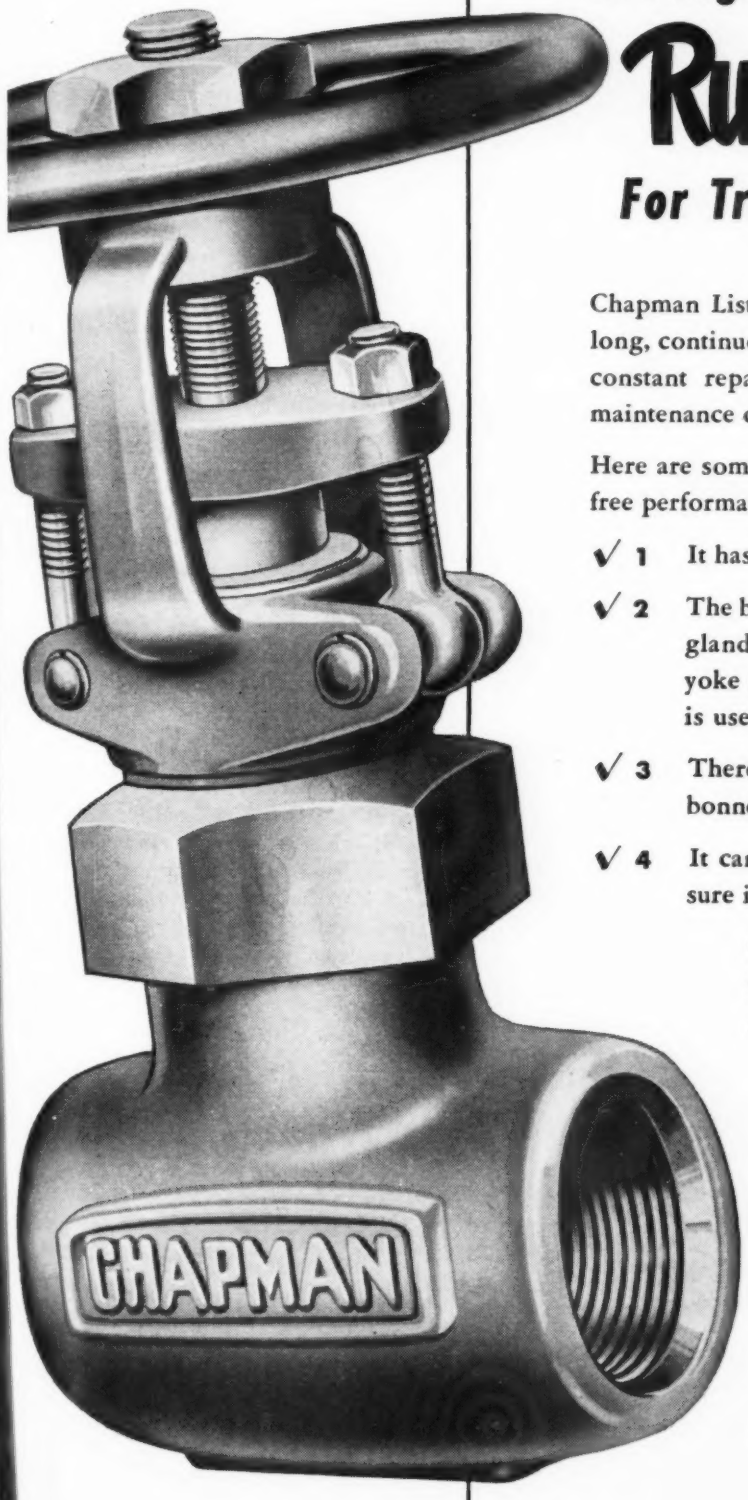
Suppose a fire starts in a coal-dirt pile in a confined corner. The bulb may not break if it is tossed on the fire; hence there is a chance it will explode when heated, and spread the fire. Also, after the bomb explodes, free gas is produced when heat of the

CHAPMAN LIST 960

A Forged Steel Gate Valve that's

RUGGEDLY BUILT

For Trouble-Free Performance



Chapman List 960 is a compact gate valve which gives you long, continuous service. Sturdily built, it eliminates the usual constant repair and replacements which tend to increase maintenance costs.

Here are some of the features which provide for this trouble-free performance.

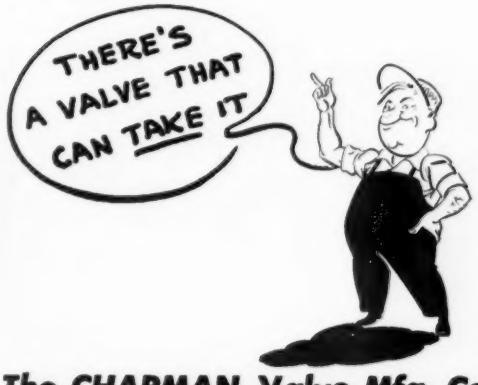
✓ 1 It has a forged body and yoke.

✓ 2 The bonnet is fitted with a flanged forged steel packing gland which eliminates exposed threading on the yoke and prevents rust and corrosion when the valve is used in exposed locations.

✓ 3 There are no gaskets to blow as in valves with bolted bonnet connections.

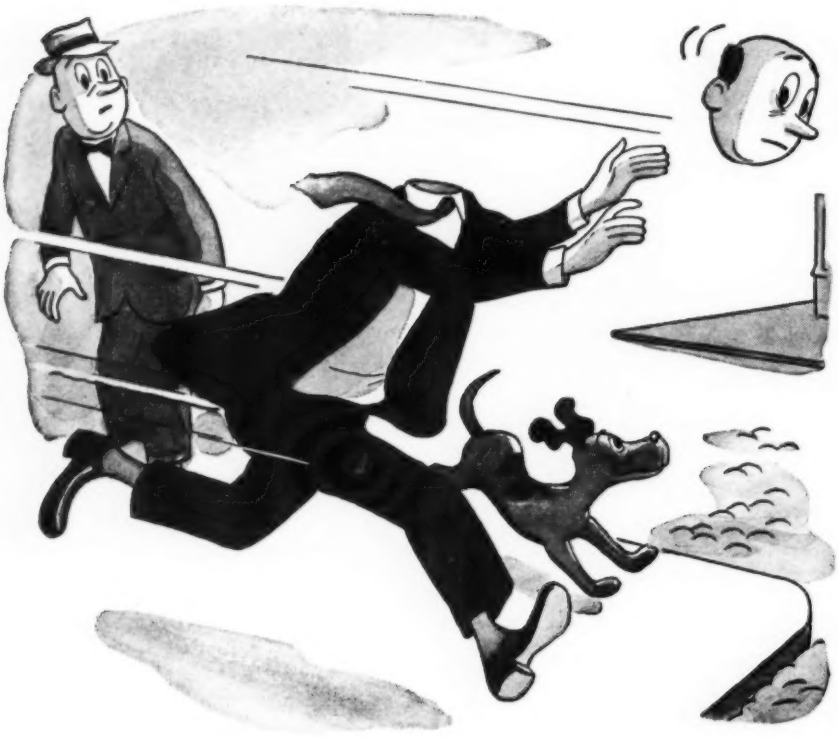
✓ 4 It can be repacked under full pressure because pressure is not transmitted to the valve stem.

Chapman List 960 is made in sizes from ¼" to 2" — in carbon steel for pressures to 800 pounds at 750° F. For higher pressures, specify List 990.



The CHAPMAN Valve Mfg. Co.
INDIAN ORCHARD, MASS.

Don't lose your head over shortages!



When you need supplies and replacement parts *fast*, specify Air Express—and forget your worries. Your shipment arrives in *hours*, not days. Air Express brings your most distant suppliers close at hand. Even coast-to-coast overnight shipments are now routine.

Because Air Express goes on every flight of all Scheduled Airlines, your shipments never "grow moss"—never have to wait around for loads to accumulate. Rates are low, and you're getting better service than ever because of faster planes and increased schedules. For better, *more profitable* customer service, use Air Express regularly.

Specify Air Express-it's Good Business

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AIR EXPRESS

AIR EXPRESS

GETS THERE FIRST

Fastest delivery—at low rates

Refrigerator parts (120 lbs.) in Detroit were needed in West Palm Beach *fast*. Picked up 4:20 PM the 16th, delivered 10 AM on 17th. 1135 miles, Air Express charge only $40.52. Other rates, any distance, similarly inexpensive and *fast*.

fire vaporizes the liquid carbon tetrachloride. The gas in this confined space becomes dangerous to anyone not protected by a gas mask.

Carbon tetrachloride should not be used on wood or rubbish fires since it extinguishes by blanketing. It is ineffective in blanketing such a fire because of the free oxygen confined within the refuse pile.

My suggestions on fire and extinguishers are: (1) Use an approved type of extinguisher. (2) Set up good housekeeping rules in your plant. Don't allow combustible material to accumulate. (3) Give careful consideration to the proper choice of fire-fighting agents or combinations of them, with special attention to advantages and limitations of each type for specific applications. (4) Train personnel in fire-fighting technique. Be sure they have a working knowledge of the fire extinguishers in the plant. Develop plans for fighting fires and conduct drills.

Tenafly, N. J. K B HOFFMAN

P Alkalinity Test For Boiler Blowdown

IN MARCH 1947, POWER, p 80, N T Pef suggests that the phenolphthalein alkalinity test can be used as a guide for regulating blowdown to control boiler-water concentration.

Doesn't this overlook the fact that calcium bicarbonate in hard water breaks down to form calcium carbonate, which is largely precipitated as scale? Therefore, the concentration of P alkalinity will not increase in proportion to the concentration of other impurities. Or, if a certain excess of soda ash is maintained (soda-ash treatment), won't the P alkalinity vary without direct relationship to the concentration of other impurities? Disodium phosphate, commonly used in boiler-water conditioning, also affects the alkalinity.

It seems to me that the best indexes of boiler-water concentration are the chloride content, conductivity, or the specific gravity as measured by a hydrometer.

New York, N. Y. W J RYAN

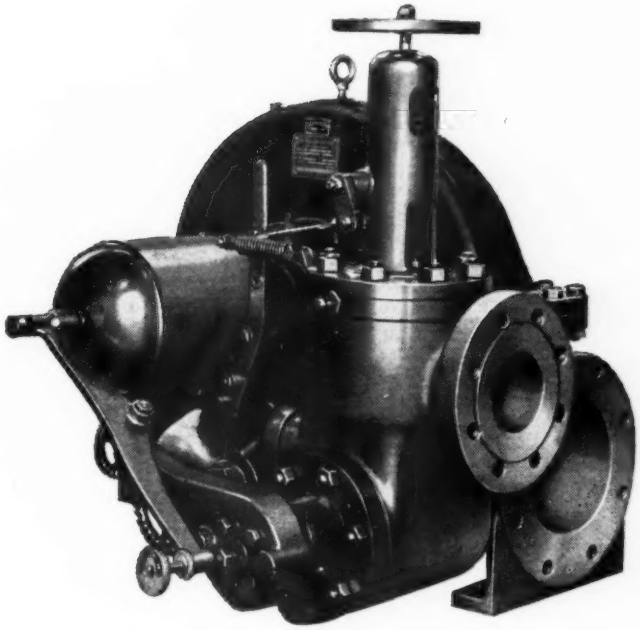
More About the P Alkalinity Test

I AGREE WITH W J RYAN, in the letter above, that scientifically speaking the P alkalinity test cannot be used to determine boiler-water concentration. But it can be and is used safely in several plants as a convenient means for controlling boiler blowdown.

In March POWER, I stated that the

NOW! QUICK DELIVERY

On Small TURBINE DRIVES*



*STANDARD (single-stage, shaft-governed) mechanical-drive turbines.

If you're up against a shortage of horsepower, here's good news—We're making deliveries on standard mechanical-drive turbines in *12 weeks or less.* The turbines are really rolling out of our new Fitchburg plant these days, thanks to standardization. The standard line (shaft-governed, single-stage turbines) ranges from 10 to 800 hp.

MANY APPLICATIONS

G-E standard turbines are ready to go to work in any plant where steam is used. They can do a multitude of jobs—driving pumps, compressors, fans, blowers, line shafts, processing machines. If you use process steam, these turbines can reduce high-pressure steam to your process pressure, at the same time producing low-cost driving power.

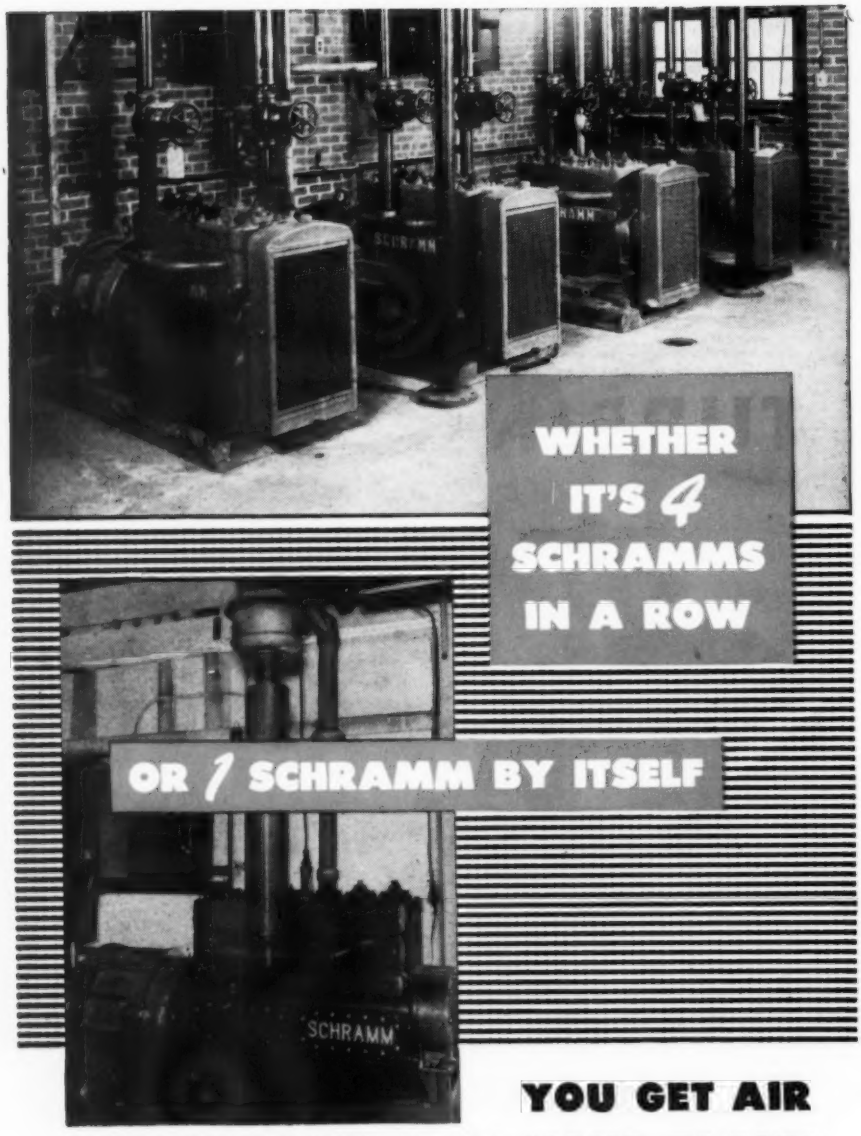
QUICK SERVICE

You can get service in a hurry when you operate G-E turbine drive. You have twenty-six service shops and 115 sales offices located throughout the country, to call on for quick and convenient aid.

GET YOUR HORSEPOWER NOW

If your plant needs more horsepower, and you have steam available, why not put economical G-E turbines to work? The turbine specialist in your local G-E office will be glad to assist you in the application of turbine drive. And—he's in position to give you fast shipment on standard designs. Call him today! *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC



YOU GET AIR ECONOMICALLY IN YOUR PLANT *anywhere*

Schramm Air Compressors can be easily installed as a unit system in plants requiring varying compressor loads and Schramm's Automatic Control makes it possible to operate them singly or in units as varying air requirements demand.

Schramm features are distinct: 100% water cooled . . . Forced feed lubrication . . . Mechanical intake valve . . . lightweight, compact, *vibrationless*. There are many compressed air jobs in plants that are ably done by Schramm.

Stationary Schramm Compressors range in size from 2 to 600 cu. ft. displacement. For construction jobs around your plant there are portable units. Regardless of your compressed air need, there is a Schramm Air Compressor available to do the work.

Write us today for complete literature.

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THE COMPRESSOR PEOPLE
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principal argument in favor of the P alkalinity test is that the color-change endpoint can be established exactly and there are no two ways about the decision when the pink color disappears. With most other tests using a color change, two operators can arrive at different results, even when they have received instructions from the same source.

For example, in making the chloride test, the first color change is not permanent. Some operators make their readings when the color change first appears, and others after the change has become stable. With some waters, there is little difference in readings between the first color change and the stable color. The difference is as much as 50% or more with other waters.

I am aware that if the feedwater has 20 ppm chloride, total solids 150 ppm, and the boiler water 200 ppm chloride we can say the boiler-water concentration is 1500 ppm.

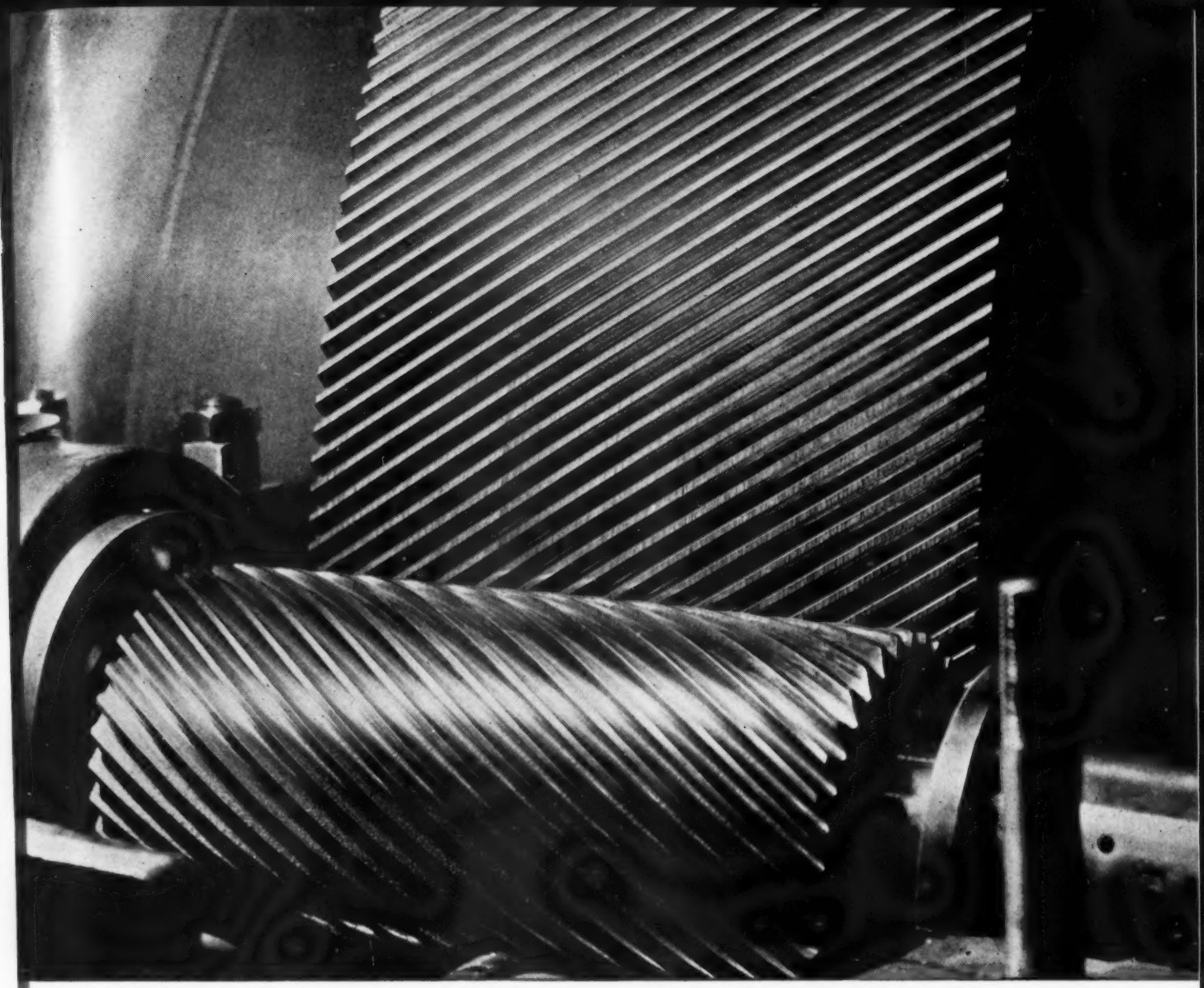
Such a relation will not be true of P alkalinity, but there is, nevertheless, a relation between the total solids of the boiler water and its P alkalinity. In other words, if P alkalinity is 400 ppm one day and 500 ppm the next, we can just as safely assume total solids have increased 25%—as if we were using the chloride test. This would not be true of the feedwater changes in the meantime, but we would not be any more accurate if we used the chloride test.

SPECIFIC GRAVITY TEST

As to reading specific gravity of the water with a hydrometer, I am not sure this method is usually more reliable than the methods I mention. I have never found the specific-gravity test widely used, nor has it always given consistent results. The conductivity meter is coming into more general use for blowdown control and is dependable, but because of its cost many boiler operators must do without it.

Another argument in favor of the P alkalinity test is that many new boiler installations use a limiting factor of alkalinity and not the total solids. One large boiler manufacturer has set a limit of 500 ppm M alkalinity and a P alkalinity at 75% of the M alkalinity. In this case, no mention is made of the total solids. That is, the manufacturer agrees to deliver clean steam and keep the boiler free of scale, corrosion and embrittlement if the M alkalinity is maintained under 500 ppm. In this plant, boiler blowdown is controlled by the P alkalinity test only.

Boston, Mass. N T PEF



Turbine gears like new after 25,500 hours with

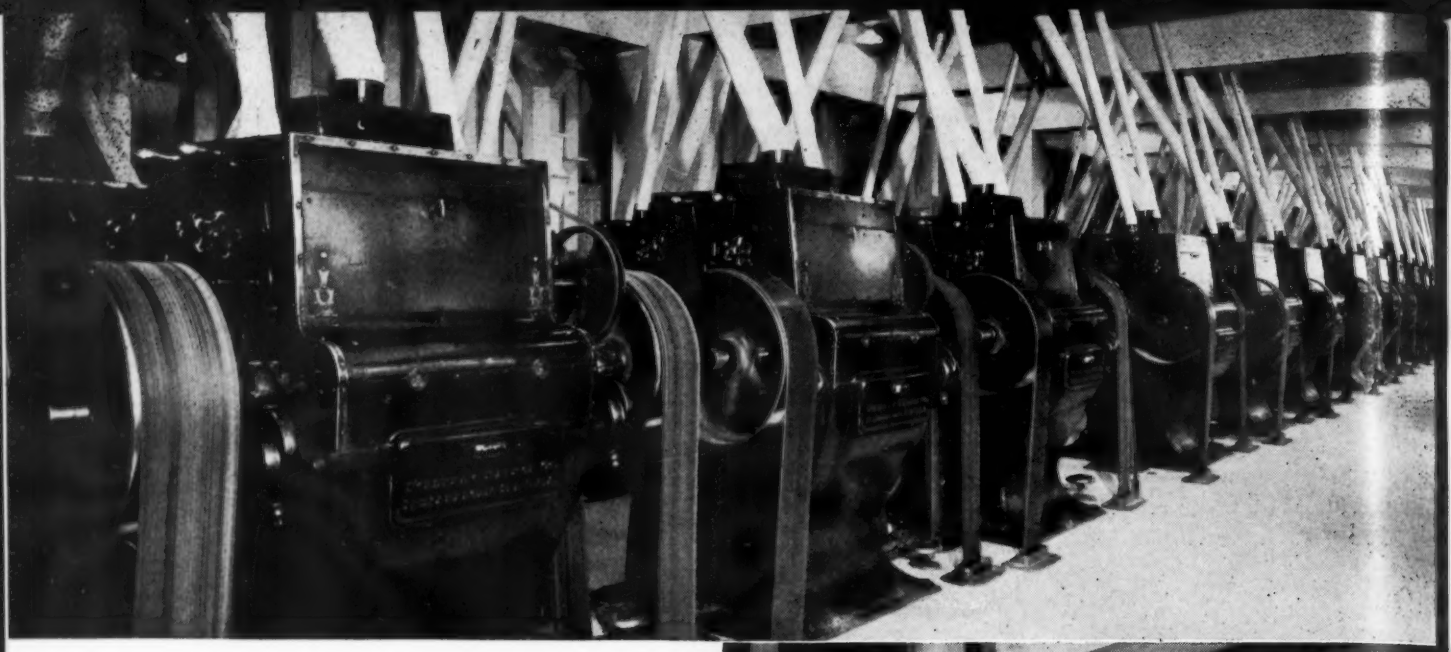
NONPAREIL
TURBINE OIL

TAKE a close look at this unretouched photograph of the gears in a 5000 KW geared turbine. It is hard to believe they aren't new. Yet they operated 25,500 hours during the war in an English paper mill. They were lubricated by the same oil that was used on the turbine bearings—Nonpareil Turbine Oil.

Not only was wear reduced to the minimum but the oil system was completely free from deposits. Oil acidity at no time exceeded the extremely low neutralization number of 0.07mgKOH/gm. The oil required neither treating nor sweetening.

Nonpareil assures protection against acidity, deposits and corrosion for gears, bearings, governors and turbine oil systems. Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

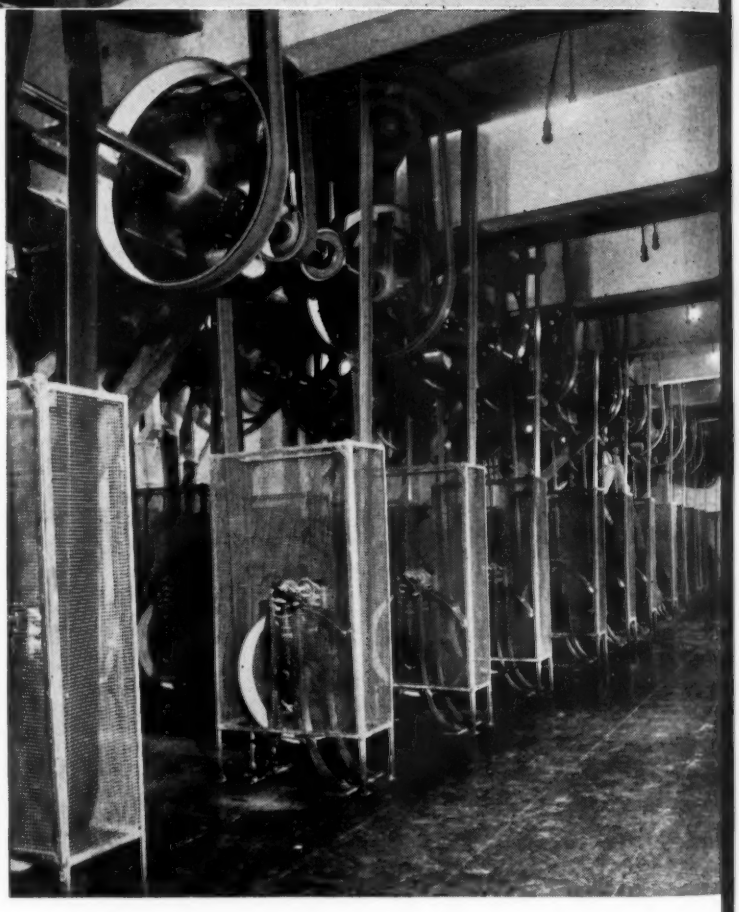


Cleaner operation...

cooler-running bearings...

lower power demand...with

Stanodrip



TESTS in a large midwest flour mill quickly proved the superior lubricating and dripless qualities of Stanodrip.

Oil leakage from ring-oiled bearings on the rolls and the line shafting had jeopardized clean operation. Overheating of roll bearings had lowered operating efficiency.

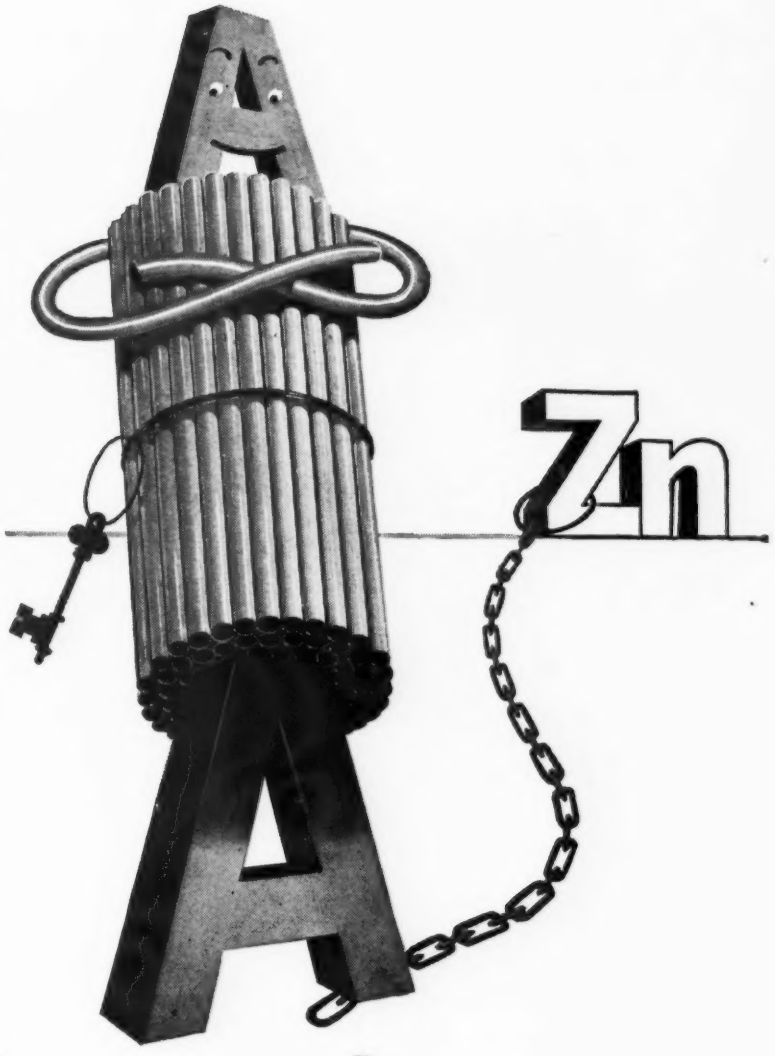
But Stanodrip stayed in the bearings, provided protective lubrication and reduced power demand for starting the mill.

Unusual stringiness and driplessness give this unique oil an adhesive quality that prevents oil throw-off or leakage. Instead of conventional soap or rubber thickening ingredients, Stanodrip contains a thickening component that resists oxidation and separation.

To test or discuss the possible advantages of Stanodrip in your plant, a Standard Oil Lubrication Engineer will be glad to call on you. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

ZINC'S always under guard!



...in Chase ANTIMONIAL ADMIRALTY*

Condenser Tubes

THERE'S very little chance of escape for the zinc in Chase *Antimonial* Admiralty Condenser Tubes. And that's a service-proved fact. Installations of Chase patented *Antimonial* Admiralty—running into the millions of pounds since 1935—have proved their greater resistance to dezincification. Obviously, such performance represents a considerable saving in tube replacement costs. And you pay no more for *Antimonial* Admiralty than for regular Admiralty.

*U. S. Pat. No. 2,061,921

Special stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses at BALTIMORE, NEW ORLEANS, LOS ANGELES, SAN FRANCISCO also carried by— Vinson Supply Co., TULSA Standard Brass & Mfg. Co. HOUSTON

Chase

WATERBURY 91, CONNECTICUT

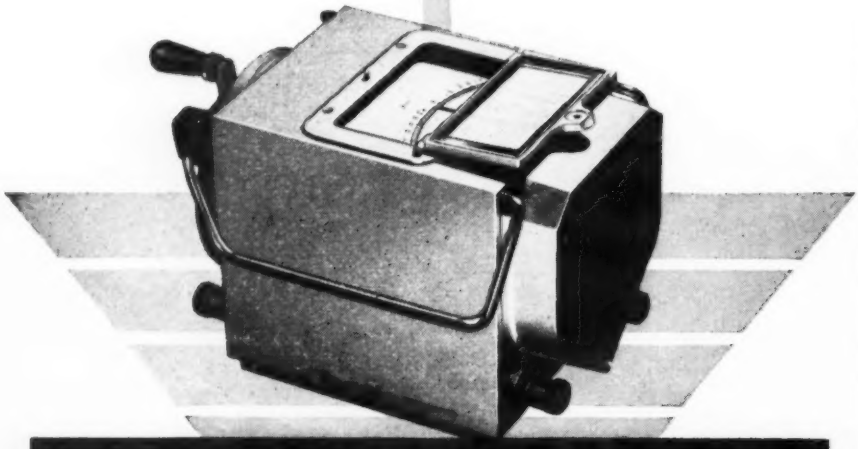
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

the Nation's Headquarters for BRASS & COPPER

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON† (†Indicates Sales Office Only)

For BETTER *and* SAFER GROUNDING



"MEGGER"* GROUND TESTER

For measuring resistance to earth of man-made ground connections, used with generating stations, substations, transmission towers, lightning arresters and machine frames. Grounding for protection . . . for insurance.

Check THESE FEATURES to see *why* the "Megger" Ground Tester is used for ground resistance measurements . . . and *how* it can do a job for you.

- Has its own hand generator; requires no batteries or other external power supply.
- Direct-reading in ohms —"Like a voltmeter."
- No calculations required.
- Only one set of connections.
- No adjustments or "balancing."
- Self-contained, rugged and portable.
- Unaffected by the exact resistance of the reference grounds.
- Unaffected by stray current in the earth either a-c or d-c, or by polarization or electrolysis.
- Covers a wide range of resistance—0-3 up to 0-30,000 ohms.
- Represents only a fraction of the cost of adequate grounding protection.

For a full description of the "Megger" Ground Testers, including the principle of operation, applications and how to use them, send *today* for Catalog 25-P.

*REG. U. S. PAT. OFF.

JAMES G. BIDDLE CO.

ELECTRICAL & SCIENTIFIC INSTRUMENTS

1316 ARCH STREET • PHILADELPHIA 7, PENNA.

Reader's Problems

(*Continued from page* 110)

banked in changeable weather.

For approximate relationships use the following: ⅓ sq ft of grate surface develops about 134.5 lb steam per hr and burns about 5 lb of 12,000 Btu coal per hr. Ten sq ft of boiler surface develops 1 rated hp and supplies steam to about 100 sq ft of radiation. One square foot of radiation heats about 100 cu ft of room volume. For accurate figures, he should make a complete heat-loss calculation.

Steam to heat the enlarged building will be about 1000 lb per hr and process-steam load may be about 2500 lb per hr. Accurate load estimates could be given only if size, type and operating hours of the equipment were known. He should plan the installation of a heat reclaimer to preheat the incoming cold water with heat in the waste water before it is dumped into the sewer.

Somerville, Mass. J P HOAR

Power From Process Steam Gives Substantial Saving

AHP HAS OPENED UP a subject that cannot be fully covered in the "problem corner." Here are some of the high spots.

He can attain a definite and substantial saving by generating either mechanical or electrical power as a byproduct of steam generated for process or heating. A careful survey should determine present and future steam and power requirements, which will dictate the equipment needed. *AHP* did not indicate the building construction or the nature of his work. So I assume brick construction, average window exposure, 300,000 cu ft total volume, and two air changes each hour. Also, heat loss of two million Btu an hour when outside temperature is ten below zero.

Two air changes each hour for a building of 300,000 cu ft total volume requires heating of 600,000 cu ft of outside air to 70 F. Considering that one Btu raises the temperature of 56.5 cu ft of air one degree F, 600,000 × 80 ÷ 56.5 = 865,000 Btu needed each hour to warm the air for ventilation. Heat to warm the building under above conditions is 2,865,000 Btu each hour. Dividing that figure by 970 we have 2.960 lb of steam required. For a vacuum-return system, exhaust steam at atmospheric pressure can be used. Figuring "rate efficiency" of radiators at 1.8 Btu per hour per degree difference per square foot and steam at 212 F, temperature difference is 212 — 70 = 142 deg; 1.8x142 = 255.6 Btu per hr per sq ft of surface. Dividing total Btu for the building by 255.6 gives 11,200 sq ft of radiator surface to warm the building.

In the power plant, I suggest a medium high-speed piston-valve engine with flywheel governor, direct-connected to the

"The Battery For Today!"
WORTHINGTON
One of many plants using Worthington multiple compressor installations in the processing of gases

THAT KEEPS AIR-COSTS FROM PILING UP A SCORE

The more compressed air or gas you use, the more you can economize with Worthington Opposed Steam Driven Compressors With over 50 years of development behind them, these rugged, tireless performers are up-to-the-minute in every last cost-saving detail. For example:

Pressure feed lubricates each side independently, reducing outage and maintenance to a minimum . . . full accessibility to all steam and air cylinder interiors by removal of rear cylinder heads only . . . modern, trouble-free bearings for uninterrupted service . . . and Worthington Feather* Valves, most efficient ever made.

Reduced Labor and Maintenance Costs

Following the Worthington formula, these modern Compressors combine high performance efficiency with minimum maintenance requirements. Their ability to do a better job, year after year, on amazingly low operating costs is familiar proof that *there's more worth in Worthington.*

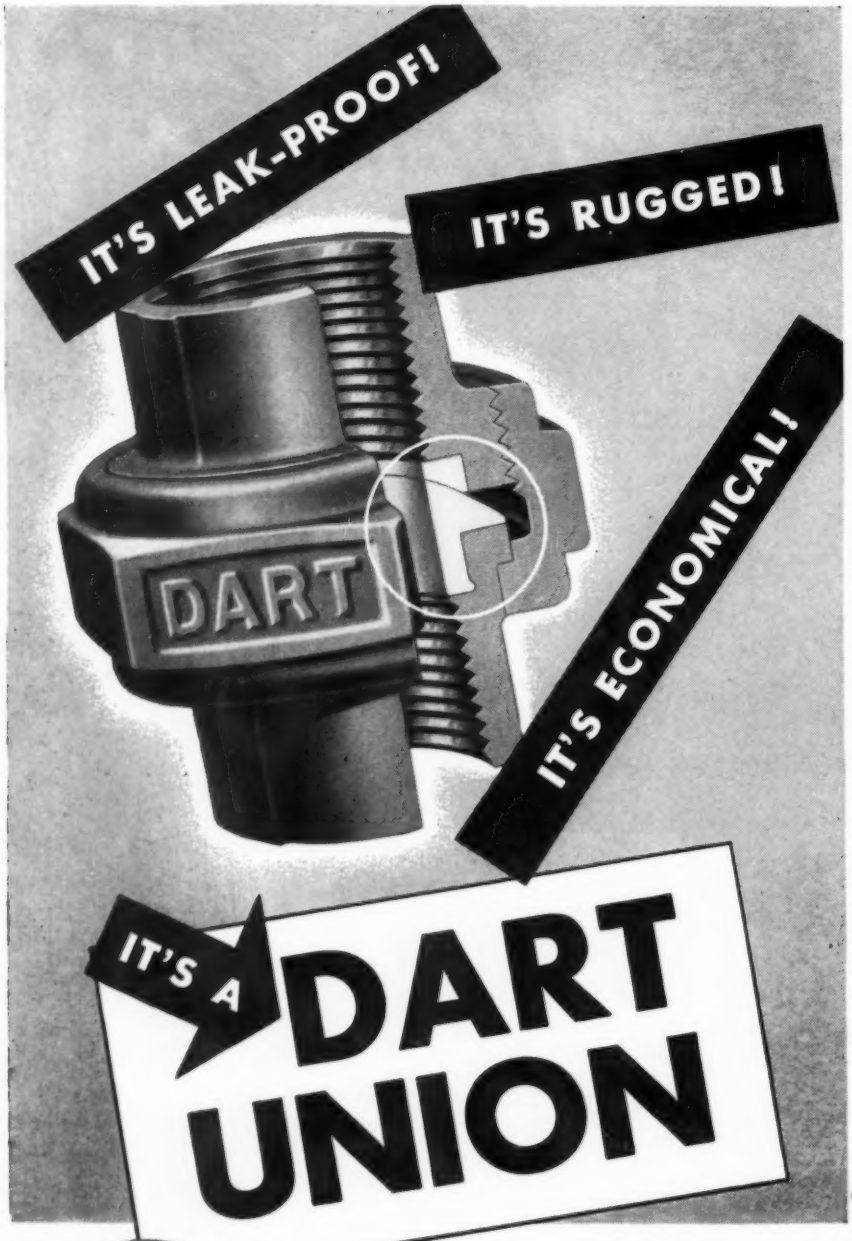
Write for Bulletin L-680-B1A. *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.* W2.7

WORTHINGTON

*Reg. U. S. Pat. Off.

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

Y-types | Vertical | Horizontal | Portable | Radial | Gas-Engine Compressors



WITH TWO BRONZE SEATS GROUND TO A TRUE BALL JOINT

That's why Darts have been leaders in unions for over 50 years. Their sound construction stands up indefinitely. Their non-corroding bronze-to-bronze seats are precision-ground to form a drop-tight connection. They close and open easily without jamming or excessive wrenching . . . and they're least expensive in the long run. Body and nut are of high-test, air-refined malleable iron—practically indestructible.

Your supplier will gladly demonstrate their points of superiority.

E. M. DART MFG. CO.
PROVIDENCE 5, RHODE ISLAND

DART UNIONS

generator, which should have the same characteristics as the incoming power system. Such a unit has a water rate of about 50 lb per kwhr. With a heating load of 2960 lb steam per hr, 59 kw of power can be generated as a byproduct at an astoundingly high steam thermal efficiency.

I recommend a 75-kw unit and a 125-psi boiler with 1250 sq ft heating surface. A liberally rated power plant runs with less maintenance and handles expansion.

If the going gets rough while *AHP* is convincing his employers, I suggest he secure two books by David Moffat Myers, one is *Factory Power Plants*, and the other, *Reducing Industrial Power Costs*, published by McGraw-Hill Book Co.

After the building has been enlarged, heating load would probably be too great for the low-pressure boiler, and the 125-psi boiler too small, but the two could be held in reserve and used when the new boiler is out of service.

Memphis, Tenn. C DEMERE

Buying Electrical Power Is Cheaper in the End

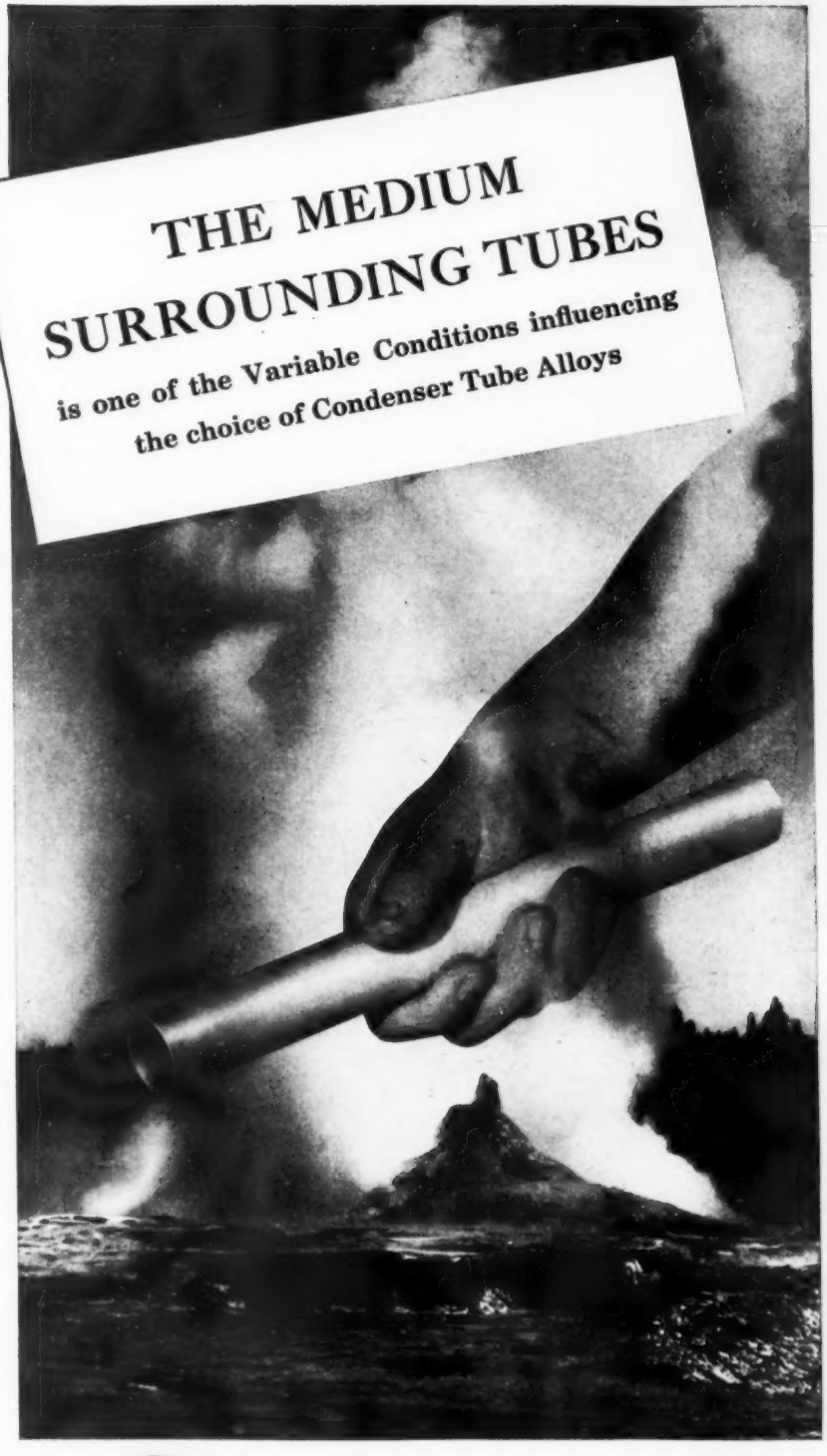
MANY CONSIDERATIONS are involved in *AHP's* problem. First, if he buys a turbine-generator with an eye to future loads he will probably buy a 100-kw machine. A generator this size would have to run at 50% capacity or less until the load increased. This condition, of course, has a telling effect on machine efficiency.

Second with only one boiler and one generator to produce power, a tie-in with the local utility is necessary for emergencies. The insurance company will more than likely insist on this. Such a hookup costs money for which *AHP* gets exactly nothing most of the time. The alternative of two boilers and two generators is, of course, prohibitive in cost.

Third, if labor costs are not to be unduly increased, the equipment must be simple to operate. This is also indicated by the small electrical load. As a general rule over-all efficiency of a turbine is in direct ratio to its size and in inverse ratio to its simplicity. Both factors tend to make for low efficiency in this case.

The thermal equivalent of a kw is, roughly, 57 Btu per minute; thus it requires 2850 Btu per minute to produce 50 kw of electricity in a perfect machine. Enthalpy of dry saturated steam at 125 psig is 1192 Btu per lb, whereas enthalpy of steam at atmospheric pressure is 1150 Btu per lb, leaving a total of 42 available Btu per lb of steam. Therefore, it takes about 68 lb of steam per minute to generate 50 kw of electricity in a perfect machine. In practice, over-all efficiency of a turbine-generator of the size suggested would probably be less than 60%, so it would require over 100 lb of steam per minute. Using 100 lb (which is low) and assuming an evaporation factor of 10 lb steam per lb of coal (which is high) it still takes at least 600 lb of coal an hour to operate the turbine-generator. This is, of course, out of the question. Also, the exhaust steam contains much more heat than the rest of this plant could utilize even in the severest weather.

The only other solution is to operate the



IN previous messages regarding selection of tube alloys for heat exchangers we have discussed the nature of coolants and their impurities. It must be borne in mind that the characteristics of the medium surrounding the tubes constitute an equally important factor in the survival or failure of the material. The degree of acidity or alkalinity and the composition of the acids or alkalis involved always will be known and the effects can be calculated. Also, consideration usually is given to the presence of oxygen or oxidizing materials, but frequently disregarded are other deleterious substances, among which are: —

1. Carbon Dioxide in aqueous solution reacts acid and accelerates corrosion, particularly if accompanied by dissolved oxygen.

2. Chlorine dissolved in water in considerable quantities may form hypochlorous and/or hydrochloric acids, actively corrosive of the metals.

3. Hydrogen Sulphide is an active corrodant even when dilute and without oxygen. With oxygen, hydrogen sulphide may form the highly corrosive acids — sulphurous and sulphuric.

4. Ammonia as moist vapor or water solution is a solvent of copper alloys and many of the brasses suffer intergranular attack, often accompanied by cracking in the presence of stresses. Whether the presence of ammonia is due to its building up in the condensate of steam condensers, to its deliberate addition without proper control to vapors for the purpose of neutralizing acids, or to leakage from contiguous refrigerating systems, it is an anathema to non-ferrous tubes.

5. Salts in solution may be beneficial or detrimental depending upon their composition, concentration, acidity, alkalinity, conductivity and other factors. Profitable discussion would have to await information on these factors.

Hydro-carbon vapors commonly owe their aggressiveness to small percentages of impurities rather than to the direct solvent action of the pure vapors.

So many variables surround any condenser or heat exchanger tube application that each case is treated as an individual problem.

Data accumulated during Scovill's continuous study of condenser and heat exchanger tube service conditions for every known application, equip its Technical Service Department to offer sound guidance in tube alloy selection for existing or proposed installations.

THREE SCOVILL SERVICES

Scovill's *Service in Men* offers experienced engineering to help solve your tube selection and installation problems. *Service in Metals* develops and produces Scovill tube alloys that conform to your requirements. *Service in Manuals* consists of literature which gives you latest, authentic information on condenser and heat exchanger tubes. For a copy of *Condenser Tube Booklet*, address Scovill Manufacturing Co., 13 Mill St., Waterbury 91, Conn. *Export Department:* 405 Lexington Avenue, New York 17, N. Y.

SCOVILL

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CONDENSER TUBES

One Product • Three Services

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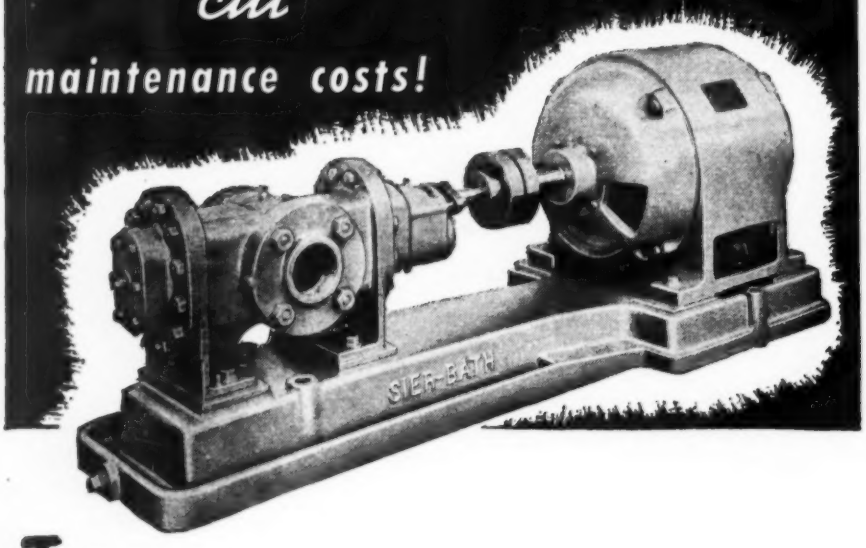
SCREW PUMPS built to SIER-BATH accuracy *cut maintenance costs!*



The high quality of design and construction of Sier-Bath Screw Pumps enables them to operate continuously for long periods without maintenance. The pulseless flow and vibrationless operation of these pumps greatly reduce maintenance cost—there is less wear on valves, couplings and other fittings. Pipes and joints remain tight and require little attention. With maintenance labor costs at an all-time high, these are important points to consider today in the selection of pumps.

Made in an up-to-date machine shop, accustomed to precision methods and equipped with the most modern machinery, Sier-Bath Screw Pumps always measure up to the highest standards required by users. They are made in both horizontal and vertical models.

Sier-Bath customers are protected from mis-application by the mature pump engineering experience of this Company's staff. Send for descriptive booklet.

ADVANTAGES:
● pulseless flow ● anti-friction bearings ● vibrationless operation
● low maintenance cost ● rugged construction

PUMPS: Acetate, asphalts, brines, Bunker C Fuel Oil, Cellulosics, Greases, Molasses, Syrups, Lube Oils, etc.

FOUNDED 1905 MEMBER A.G.M.A.

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Sier-Bath GEAR and PUMP CO., Inc.

9254 HUDSON BLVD. NORTH BERGEN, N. J.

steam turbine condensing and supply it with superheated steam. This requires a different boiler, an expensive turbine installation and trained personnel, which means increased wages.

It is exactly because of these considerations that many industries, with an electrical load several times that in *AHP's* plant, prefer to buy electricity from the local utility. Unless there are special circumstances it will pay him to do the same.

On the other hand, should such circumstances be present, *AHP* should investigate the possibility of a diesel-generator for his electric load. He can keep his present boilers to meet heat requirements of his building.

Paterson, N. J. F M GIORDANO

Answers to Question 2

(*Continued from page* 113)

Some years ago I worked in a diesel plant where the exhaust of two diesel engines was utilized in two waste-heat boilers to generate hot water and low-pressure steam.

An automatically controlled butterfly valve in the exhaust gas line near the boiler regulated gas flow through boiler or bypassed it to atmosphere. If *RCE* uses a low-pressure waste-heat boiler he will have plenty of hot water the year around. Pressure of 10 or 15 psi on the boiler will probably force hot water to desired locations.

Montreal, Que. ARTHUR BELTON

Diesel Lube Oil

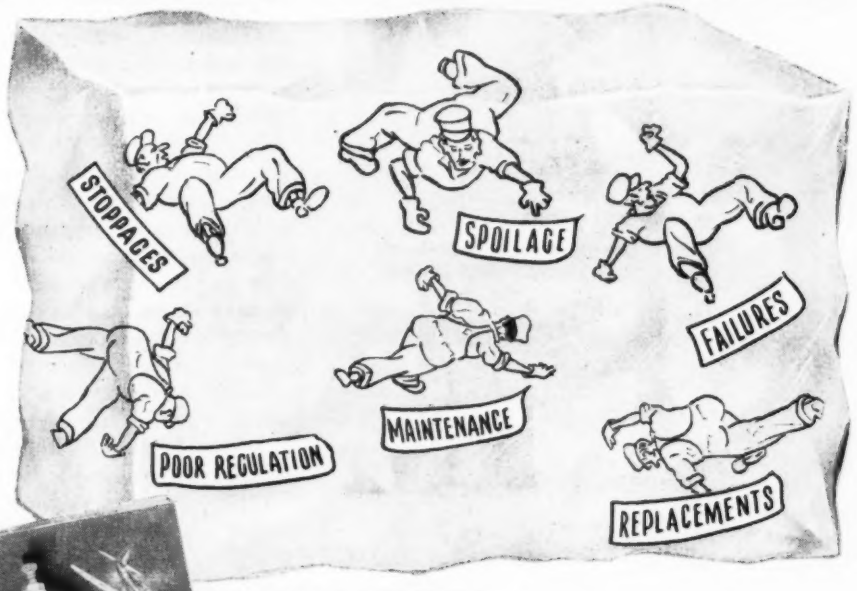
(*Continued from page* 78)

a makeshift to compensate for a large factor of ignorance."

Viscosity. For our general purpose, viscosity is the most important single property. It determines load-carrying ability under conditions of full fluid lubrication. It affects power output and heat generation in bearings, governs sealing effect of the oil and also bears a direct relation to oil-consumption rate for any unit or engine under test. Oil of proper viscosity is essential.

Viscosity may be defined as a measure of resistance to motion or flow of any liquid or gas. Fundamental units of viscosity are the *poise* and *centipoise* (1/100 of a poise). Because it is inconvenient to measure viscosity in these *absolute* units, we measure flow rate of liquid under its liquid head through a small orifice in the bottom of a container. The instrument commonly used is the saybolt universal viscosimeter. It measures viscosity as the time in seconds for a standard quantity at given temperature to flow through a standard orifice. A more accurate instrument now also in general use is the kinematic vis-

PUT THESE *Troublemakers* ON ICE IN YOUR PLANT...



READ THIS

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

Bulletin 962

AND SEE WHY YOU CAN DO IT

A USER SAYS: "We have had many expensive pilot operated steam pressure regulating valves for our process work which require a tapering steam flow down to practically zero consumption. The normal pressure reduction is 180# to 20#. The smallest of these valves that we could buy, would wire-draw in a short time and give no regulation at our low-flow demands.

A couple of years ago, we began to purchase CASH STANDARD 1000 valves for this service. We now have exact pressure regulation at all steam flow rates down to dead shut-off and have had absolutely no occasion to service these valves.

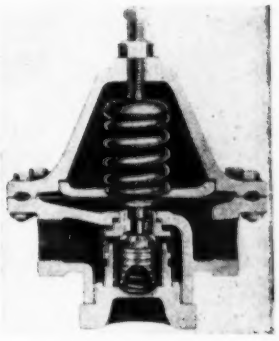
We now intend to purchase these Streamliners for our heating steam lines where there is a wide range of thru-put, with long periods of practically no flow."

CASH STANDARD CONTROLS... VALVES

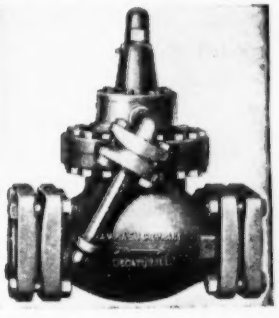
A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

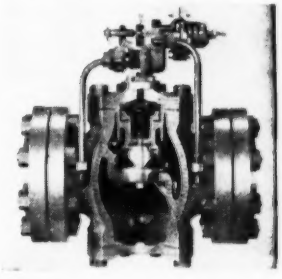
Send for them



Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.



Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.



Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.

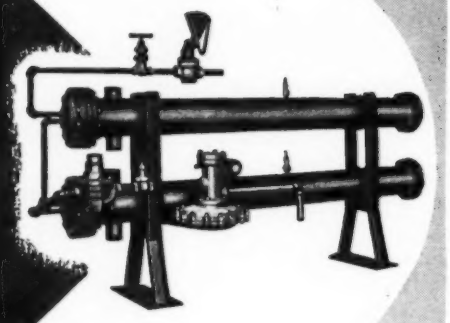
HENSZEY CONTINUOUS BLOWDOWN

Prevents PRIMING

Prevents FOAMING

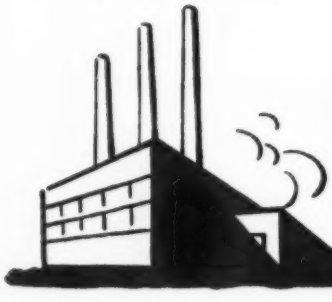
Prevents SLUDGE

Prevents SCALE



The Henszey System automatically keeps boiler water concentrations within safe margins — prevents foaming, priming, carryover and the formation of sludge and scale (with simple chemical treatment). This is accomplished continuously WITHOUT the HEAT LOSS of ordinary intermittent blowdown.

Maintain clean, efficient boilers with Henszey Continuous Blowdown for substantial savings in fuel, equipment and manpower . . . savings you need to hold down costs of production. Plan on a Henszey Continuous Blowdown System for your present — or future — power plant.



Consult your nearest HENSZEY representative or write to

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and BOILER PLANT SPECIALTIES

Boiler Feed Regulators • Distillation Systems • Heat Exchangers

Feed Water Meters • Flow Indicators • Proportioning Valves

also MILK EVAPORATORS and PREHEATERS

cosimeter, which uses a capillary to determine resistance to flow of fluid. The kinematic viscosity is expressed in *centistokes* and may be converted to saybolt seconds or centipoise units.

All petroleum products, like other liquids, vary in viscosity as temperature changes, getting thicker as they fall and thinner as they rise. Rate of viscosity change with temperature varies widely for different types of oils. *Viscosity index* is an arbitrary standard based on comparison with relative rates of change of viscosity with temperature of two standard sets of oils having high and low rates of change. If we know saybolt viscosity of an oil at 100 and 210 F, we can compute its viscosity index but it should be remembered that viscosity index is no more accurate than the viscosity determinations at these two temperatures. Small errors in the 210-F viscosity of light oils lead to relatively large errors in viscosity index.

Thus, importance should not be placed on viscosity-index differences when they are so small as to have no practical significance. Many consider oils of relatively high viscosity index as preferable. Where low-temperature starting is an important factor, this may be correct. Oils of relatively low-viscosity index, however, show other advantages in some types of service. Since viscosity index can be modified by additives without appreciably changing other characteristics, this property should be considered with all other properties in relation to intended service. Never consider one oil better or worse than another because of viscosity-index differences alone.

Color Test. The commonest method for color determination employs the ASTM Union Colorimeter (D155-39T). Oil in a tube of specified size is compared with glass color standards. Color values in lubricating oils enjoy significance only in production control where they may serve as an index of uniformity. At one time it was thought that pale color showed low viscosity, but this is not true. Color is no criterion of quality; in fact, certain oils of dark color may display marked advantages over pale oils for some tasks.

Conradson Carbon Residue. This test (D189-41) was developed in an attempt to show amount of carbonaceous residue an oil might be expected to leave when subjected to evaporation under high-temperature conditions, such as are met in internal-combustion engines. As a general rule, oils from any given crude type show increasing residues with increasing viscosities; furthermore, distillate oils show lower values than residuals, such as bright stock. Naph-

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Wherever it's "SAFETY FIRST"

DEPEND on Youngstown's Buckeye Conduit for safety in electrical wiring. It is a standard-threaded, full-weight, rigid steel conduit of uniform, high quality. It provides the surest known protection against moisture, vapor, dust, crushing, vibration, and tampering by unauthorized persons.

Remember that this type of conduit is the only wiring system approved for hazardous locations by the National Electrical Code. So for Safety First, look for the underwriter's label bearing the name Youngstown on every length of conduit.

"Buckeye" is sold by leading electrical distributors in every industrial market.

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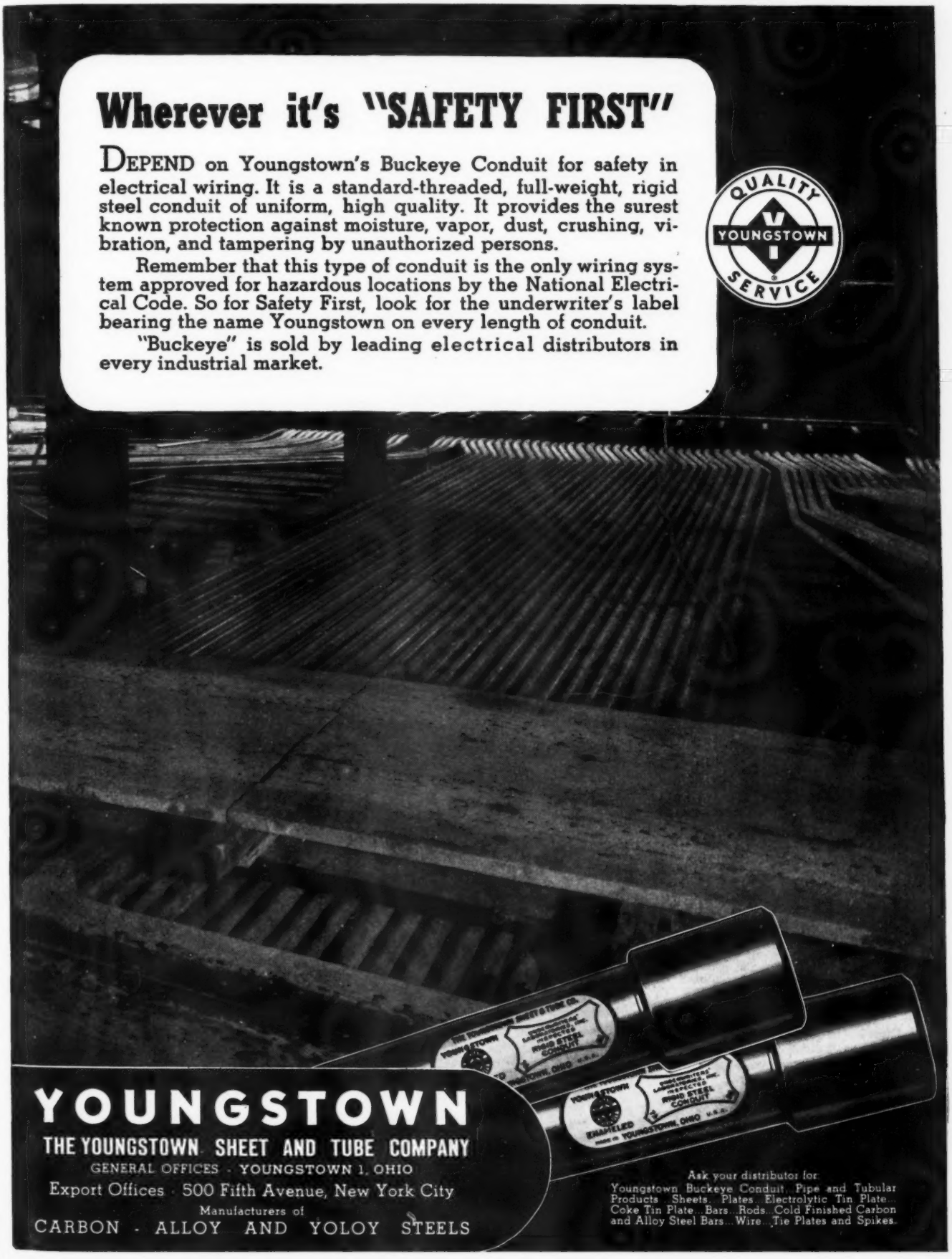

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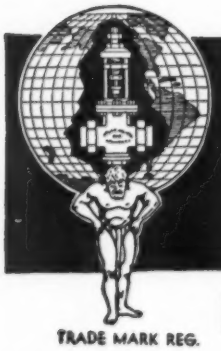

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TEMPERATURE REGULATORS

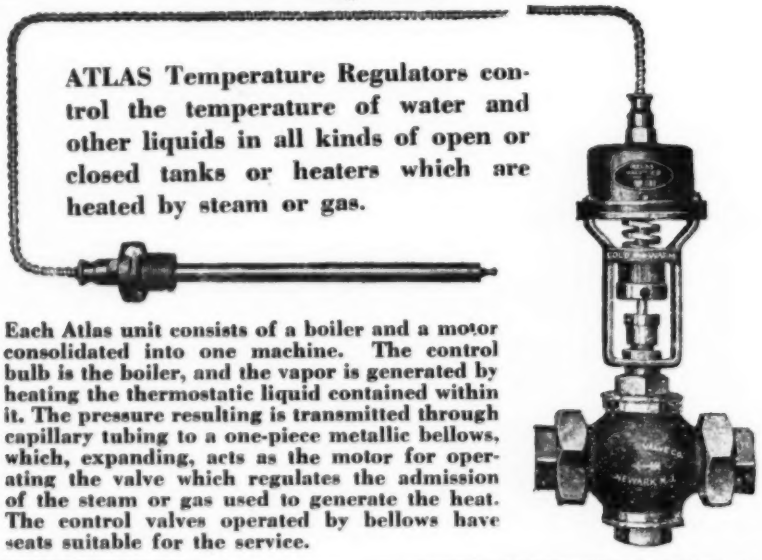
ATLAS

1. They Are Self-Contained.

2. They Maintain Perfect Control of Temperature of Liquids.

Write for Bulletin 7A giving detailed information

ATLAS Temperature Regulators control the temperature of water and other liquids in all kinds of open or closed tanks or heaters which are heated by steam or gas.



Each Atlas unit consists of a boiler and a motor consolidated into one machine. The control bulb is the boiler, and the vapor is generated by heating the thermostatic liquid contained within it. The pressure resulting is transmitted through capillary tubing to a one-piece metallic bellows, which, expanding, acts as the motor for operating the valve which regulates the admission of the steam or gas used to generate the heat. The control valves operated by bellows have seats suitable for the service.

Number	Specifications
ATLAS No. 650	Balanced Type Double Seat Valve. Spring Adustment. For temperatures from 70° to 300° F. Bulb is immersed in liquid and control valve installed in steam supply. ½", ¾", and 1" for steam pressures up to 150 lb. 1¼", 1½", 2", and 2½" for steam pressures up to 100 lb. Operates in vertical or horizontal position.
ATLAS No. 651	Needle Type. Single Seat Valve. Spring adjustment. For temperatures from 70° to 300° F. Used where tight seating valve is essential such as on small oil heater pump sets, open or closed tanks, sterilizers, glue heaters, etc. ¼" and ¾" for steam pressures up to 150 lb. Operates in vertical or horizontal position.
ATLAS No. 655	Balanced Type. Double Seat Valve. Lever and Weight Adjustment. For temperatures from 70° to 300° F. Lever and weight adjustment of control valve assure high sensitivity. For maintaining temperature of liquids in all kinds of tanks and heaters. ½", ¾", and 1" for steam pressures up to 150 lb. 1¼", 1½", 2", 2½", 3", 4", 5", 6", and 8" for pressures up to 100 lb. Operates in horizontal pipes.
ATLAS No. 660	Single Seat Self-Contained Pilot Operated Valve. Spring Adjustment. For temperatures from 70° to 300° F. For use where accurate regulation demands a quick opening and closing control valve and where steam pressure is always 25 lb. or more, as for instantaneous heaters and tanks for water, oil, etc. ½", ¾", 1", 1¼", 1½", and 2" for steam pressures up to 300 lb. 2½", 3", and 4" for steam pressures up to 250 lb.

Other Atlas Products

Check the items at the right on which you would like to have data and mail to us with your name, firm name and address.

- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Reducing Valves
- ☐ Exhaust Control Systems
- ☐ CAMPBELL Boiler Feed Water Regulators
- ☐ Pump Governors
- ☐ Pressure Regulators
- ☐ Float Valves
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

289 South St., Newark 5, N. J.

Representatives in Principal Cities

thenic oils show smaller carbon residue than paraffinic oils. The more drastic the treatment given an oil, whether by solvent refining or acid treating, the lower the conradson carbon will be. Any oil, if conventionally refined, generally shows larger carbon residue than if solvent refined.

While it may be true that the carbon-residue value might show amount of deposit to expect in an engine, design and operating conditions, particularly character of fuel and fuel-air ratio, exert an equally important effect on cleanliness. It should be noted here that metallic or other additives compounded with an oil to decrease engine deposits tend to increase carbon-residue values, as determined on a new oil. This only proves that the conradson carbon test is of much less significance than service results in engines and the setting up of arbitrary values might rule out superior lubricating oils.

Neutralization Number. The neutralization number was originally used to assure freedom from mineral acids remaining after refining. Properly refined oils containing no additives show initial neutralization numbers below 0.10. Slight variations have no significance as it is difficult to duplicate test results even on the same sample. Oils containing either acid or alkali additives may show neutralization numbers varying considerably from true neutral values. These additives are used to increase oil stability or oiliness or to give detergent qualities. The resulting higher neutralization numbers should not be considered indicative of potential corrosion of engine parts. Therefore, use of neutralization number in lube-oil specifications is not desirable, particularly if low values are called for. No general correlation between service results and neutralization number has been determined, because engine operating conditions, type of base oil and fuel exert more influence on bearing corrosion.

Detergency. Straight mineral oils do not possess the property of detergency to any appreciable extent but with additives this characteristic can be obtained. Detergency can be explained as the ability of an oil with its additives to: (1) disperse and suspend within itself fuel soot and other decomposition products, and (2) remove materials which might coagulate and separate from oil and deposit on engine parts. Detergency is thus the property possessed by soaps in cleaning agents. While it is true that much of the sludge, lacquer and other deposit-forming material may be removed as it collects in the oil by means

high ratios?

✳ ONE OF 93

DE LAVAL DOUBLE REDUCTION WORM GEARS

De Laval double reduction speed reducers, consisting of combinations of double worm gear reductions, or helical and worm gear reductions, are available with overall ratios up to approximately 8000 to 1. De Laval single reduction worm gear speed reducers are available in ratios up to 90 to 1. If high ratios are your requirement, worm gear speed reducers are the answer—particularly if space is limited and reliability is important. A De Laval representative will help you pick the right size and type.

✳ This double reduction De Laval Worm Gear Speed Reducer is available in many standard ratio combinations, with horizontal or vertical output shafts and is but one of 93 sizes of standard De Laval Worm Gear Speed Reducers.

DE LAVAL

Worm Gear Division **— De Laval Steam Turbine Company, Trenton 2, N. J.**

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WG-14

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

RODA

High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER

A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE

Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER

Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

LYNCO

High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Vgn. Ry.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO

Unexcelléd Steaming Coal from the Fire Creek Seam in Greenbrier County, W.Va., originating on the N.F.&G.R.R.

ANTHRACITE — Hazle Brook Premium . . . Raven Run

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CINCINNATI NEW YORK NORFOLK PITTSBURGH

of active filters and by frequent crankcase drainage, some products cannot be filtered out and form deposits even when all other conditions are good. Detergent oils are valuable in maintaining engine cleanliness in such cases.

Tests for full detergency have been determined by service results on a large number of engines. This arrangement is the only known reliable method of determining detergent quality of an oil.

The foregoing comments on the inspection type of specification items lead to the conclusion that their main value, as far as the purchase is concerned, lies in the ability to assure constancy of production control. Oils for diesel lubrication must be bought with assurance of satisfactory service operation. Many auxiliary laboratory tests are conducted by the lubricant manufacturer aimed at evalution, but these tests are not suitable for purchaser use since they involve a specialized knowledge of petroleum and the particular stocks the refiner uses.

The final and only reliable method is the use of service-type tests in the engine. Reputable lubricant manufacturers maintain laboratory facilities for such engine testing. Cooperative work by the refiners and the engine builders has resulted in a series of tests designed to emphasize the various service needs.

This group of tests was eventually set up as the requirements for minimum-quality heavy-duty diesel oils under Army specification 2-104B. Oils designed for heavy-duty service, using additives of known characteristics based on past testing. can be evaluated by these tests.

Conclusions. In summarizing the value of specifications to the buyer of lubricating oil, it can be said that their primary value lies in determining the uniformity of the product received. With the exception of viscosity, specifying oil characteristics. as such, cannot be claimed to assure the purchaser the product needed for a given service. On the other hand, the refiner finds specifications extremely valuable for production control.

It is difficult, in setting up purchase specifications based on tests for gravity, flash. fire, pour, etc. to avoid losing sight of the primary job of the oil, that is, to lubricate the engine in the most economical and effective manner. A tendency arises to view the specifications as an end in themselves rather than as devices aimed at securing the proper product. The owner or operator buying a lubricating oil is not really buying oil. he is buying service performance; any specifications that do not contribute to this end are valueless.

CHANGE SPEEDS QUICKLY WITH ALLIS-CHALMERS NICKEL CAST IRON *Vari-Pitch* SHEAVES

Permitting speed variations from 15 to 25% *Vari-Pitch* sheaves make it easy to change machinery speeds.

Built in sizes to fit all standard motors up to 300 horsepower, these sheaves are an Allis-Chalmers product...with bodies of Nickel alloy cast iron to assure long, low-cost performance.

The dense grain and high machinable hardness of this Nickel cast iron aids in the production of long wearing sheaves that maintain their efficiency over long periods of service.

Ask us for information about the advantages Nickel alloyed irons provide for specific applications.

EMBLEM OF INCO SERVICE
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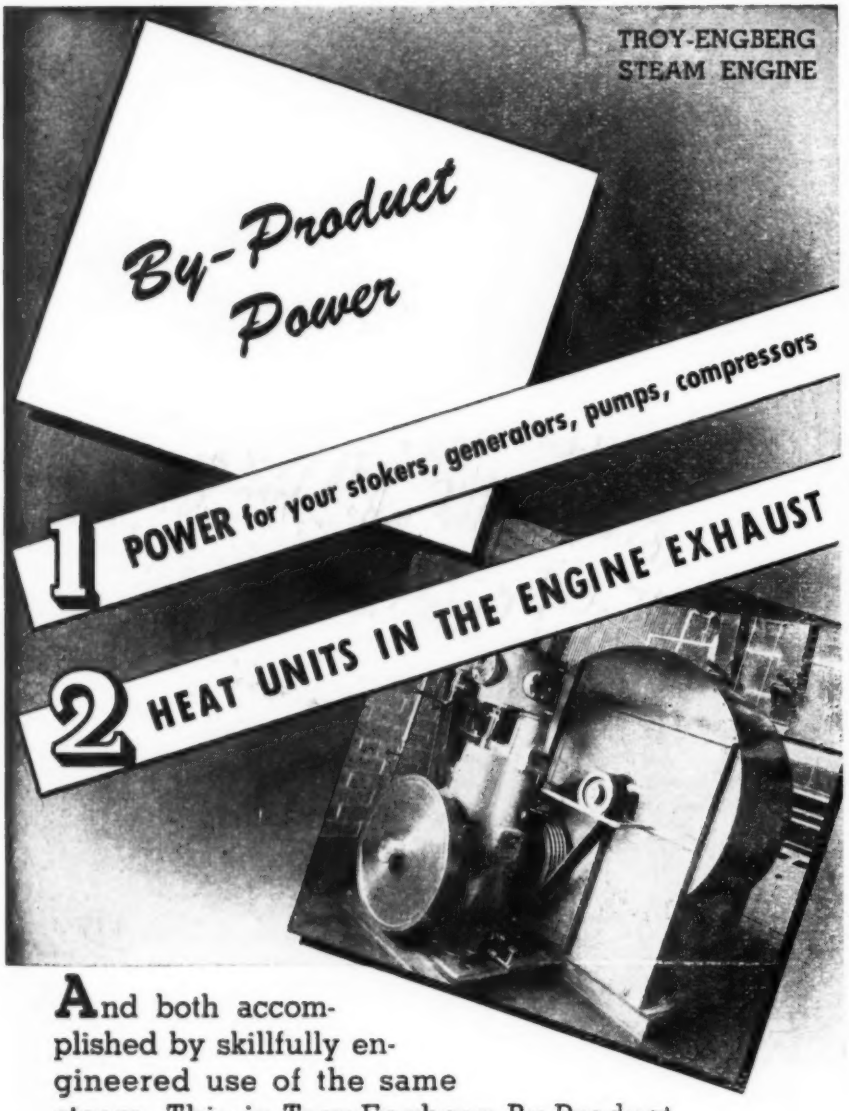
Over the years, International Nickel has accumulated a fund of useful information on the selection, fabrication, treatment and performance of engineering alloy steels, stainless steels, cast irons, brasses, bronzes and other alloys containing Nickel. This information is yours for the asking. Write for "List A" of available publications.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.


TROY-ENGBERG
STEAM ENGINE
By-Product Power
1 POWER for your stokers, generators, pumps, compressors
2 HEAT UNITS IN THE ENGINE EXHAUST

And both accomplished by skillfully engineered use of the same steam. This is Troy-Engberg By-Product Power at work.

Use the modern Troy-Engberg Steam Engine to drive stokers, blowers, fans, compressors, mixers, generators and pumps—THEN use the exhaust from the engine for your processing or heating, or both.

Cut Power Costs by putting your steam fully to WORK. Write us for detailed information on applying Troy-Engberg By-Product Power to your plant.

Send for Bulletin 306

TROY ENGINE & MACHINE COMPANY
Established 1870
2500 Railroad Avenue Troy, Pennsylvania

TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

New Equipment

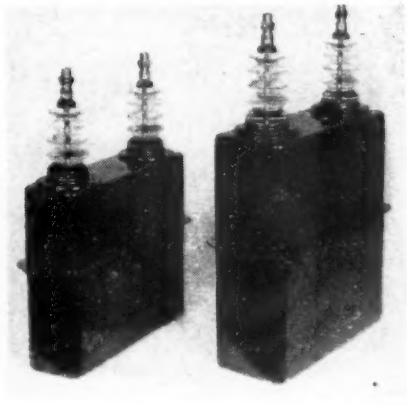
(*Continued from page* 140)

Remote speed control can be accomplished by use of a flexible shaft, up to 10 ft. For complete remote control, a small pilot motor can be used to drive the speed-control mechanism. Applications include driving textile machinery, draft fans, stokers, small paper machines, wire drawing machine, laundry ironers, dough mixers, cement kilns, stamping presses and pumps.

Uniform cooling with low-intake velocity is provided by double-end ventilation. Overload protection and limit switches to insure proper starting are built into the motor. Standard frames 225 to 505 have NEMA mounting dimensions. *Formex* wire is used in the stator and a cast-iron bearing inclosure affords protection from moisture and dirt.

The motor is rated on a constant-torque basis. It will carry full-load torque at rated current and frequency without exceeding a temperature rise of 40 C on high speed or 50 C on low speed. Power factor is high when motor is running at high speed. At synchronous speed, power factor is about the same as a squirrel-cage induction motor for similar ratings.

For inermittent use, speeds below minimum rating may be obtained by adding secondary resistance. Plugging is possible by the same means. The motor is reversible by changing two power leads. Inspection plates may be removed for inspection of brushes and brush-shifting mechanism. **General Electric Co. Schenectady 5, N. Y.**



Pyranol Capacitors E59

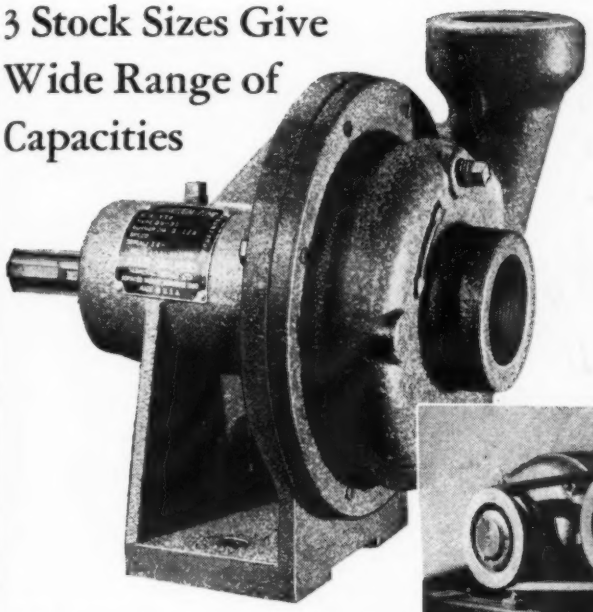
THESE NEW 25-KVAR *Pyranol* distribution capacitor units for individual and group pole mountings are similar to the individual pole-type 10- and 15-kvar units, standard with many electrical service and industrial companies. Use of these new capacitors involves fewer units to be handled, less surface exposed to the weather, and fewer hangers, bushings and connections. The small increase in size of these units over the present 15-kvar units permits using them on the same universal standard hangers. These power-factor-improvement capacitors also use the new

BUY THIS NEW PUMP

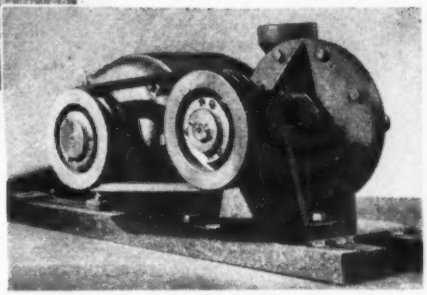
"Off-the-Shelf"

IT HAS MANY APPLICATIONS

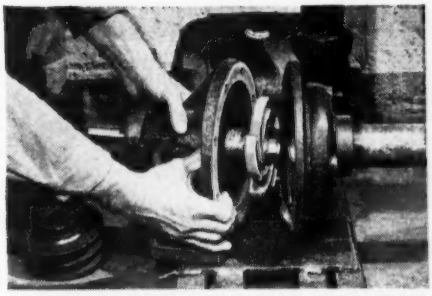
3 Stock Sizes Give Wide Range of Capacities



THE NEW "Pedrifugal"* Pedestal Type CENTRIFUGAL PUMP



BUY IT "OFF THE SHELF" — Pump can be bought "bare" or as a complete unit pump motor, Texrope drive and welded steel base Also can be coupled or belted to a motor, a gasoline engine or power take-off which you already have.



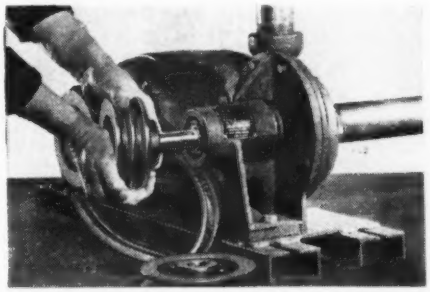
DESIGNED AND BUILT FOR SIMPLIFIED MAINTENANCE — All moving parts quickly accessible without disconnecting pipes. No packing rings to replace . . . bearings have 3 to 5 year supply of grease under normal operating conditions.

THROUGH SIMPLE CHANGES in V-belt drive, impeller or casing these new pumps meet all average pumping requirements up to 500 gpm and heads to 100 ft.

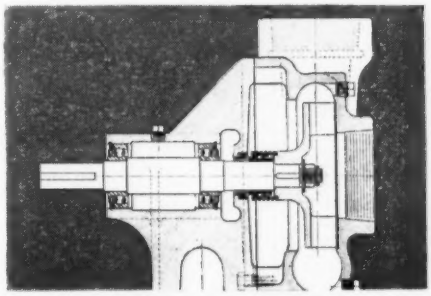
They were designed for the average user, who does not need a pump of special design or specification, but who does want a thoroughly reliable pump at a reasonable price, that he can buy right out of stock, and adapt to his needs.

The new "Pedrifugal" pump is built up to highest Allis-Chalmers standards in design, materials and workmanship. It is thoroughly tested, and backed by 65 years of engineering leadership in the design and construction of fine centrifugal pumps. Find out more about this new pump at your nearest A-C office or dealer. For specifications, ask for Bulletin 52B6691. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 2306



V-BELT DRIVE GIVES GREAT RANGE OF CAPACITY — The Pedrifugal pump is specially designed for flexible TEXROPE V-belt drive Changing one sheave quickly changes speed and capacity of the pump . . . gives you great flexibility.



HIGH GRADE CONSTRUCTION — Two large ball bearings, grease sealed . . . High grade mechanical shaft seal . . . Heavy 1 in. machined shaft with *key ways* and impeller lock nut . . . Bronze open type impeller . . . Heavy, generous design throughout.

*Allis-Chalmers Trademark

ALLIS·CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

1847 1947 A CENTURY OF SERVICE to Industry THAT MADE America Great

...with De-ionized Water for your boiler feed

ILLCO-WAY It's easy to eliminate silica from your list of boiler feed troubles! ILLCO-WAY De-ionizers *now remove silica by ion exchange.* Silica in feed water for high-pressure systems is reduced to less than .5 ppm!

ILLCO-WAY With this same equipment you prevent boiler scale, corrosion, and embrittlement—because De-ionized Water is free from dissolved solids. ILLCO-WAY De-ionizers will produce thousands of gallons of silica-free water for only a few cents.

ILLCO-WAY Investigate this new process that keeps your boilers clean by ion exchange. Long a pioneer in water treatment engineering, ILLCO-WAY now offers the new scientific way of De-ionizing to "Stop Old Man Silica." Write for literature today.

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TESTED IN THE LABORATORY • ILLCO-WAY • PROVED IN THE FIELD

Boiler Feed-Water Treatment

Complete equipment for Chemical Processing: Purification of industrial wastes, Separation of Chemical Solutions, Purification of Chemical Solutions, Reclamation of Valuable Constituents.

glass bushing which permits a mechanically strong, hermetic seal that is permanently moisture-tight. **General Electric Co, Schenectady 5, N. Y.**

Hot Lime-Soda Softener E60

NEW DESIGN of hot lime-soda water softener comes in five types that cover a wide range of conditions and requirements. Equipment has a deep sludge blanket through which raw water percolates upwardly. Sludge blanket assures thorough contact of water with lime and soda ash, which it contains to provide complete chemical reaction. Sludge bed acts as a contact filter, reducing the turbidity so there is less load on filters.

Each type includes provisions for chemical feed, vent condenser, filters with backwashing water recovery so the wash water does not pass through or disturb sludge bed, and special automatic desludging valve that controls sludge bed depth. **Liquid Conditioning Corp, 114 E Price St, Linden, N. J.**

Thermostat E61

UNIT-HEATER THERMOSTAT combines compact design into a line-voltage control instrument that can be used for either cooling or heating applications. Case is 2x4x1½ in. Adjustable stops are available so that locked settings can be obtained and the operating range limited. Contact rating is 10 amp at 115 v, 5 amp at 230 v, noninductive loads. **Barber-Coleman Co, Rockford, Ill.**

Induction Motor E62

THIS NEW 2-POLE squirrel-cage induction motor is an addition to heavy-duty line for such high-speed applications as boiler feed pumps, oil pipeline pumps, centrifugal pumps, compressors and blowers. Rated

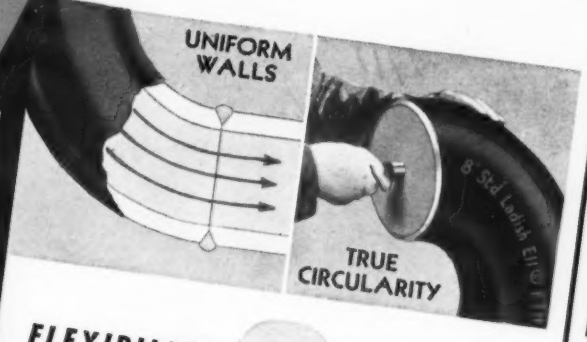
(*Continued on page* 172)

You Reduce ERECTION Costs ...When You Install LADISH Seamless Welding Fittings

THESE 4 WAYS

RAPID, POSITIVE ALIGNMENT...

Installation is swift and sure with sound, uniform welds at lower cost through the rapid, positive alignment of Ladish Seamless Welding Fittings. Matching the pipe accurately in both wall thickness and circularity, OD alignment insures perfect ID alignment . . . offsets are eliminated and smooth, uninterrupted flow results without the danger of erosion pockets.



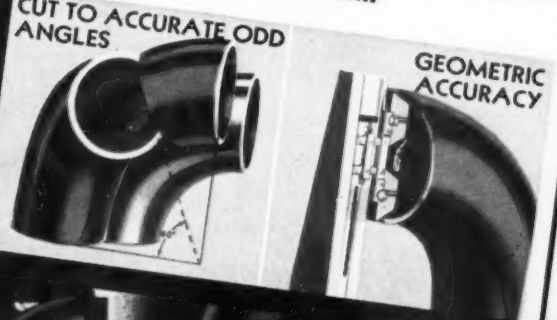
SOUND, UNIFORMLY FAST WELDS

Strong, sound welds are an important installation economy which results from controlled metal purity and accurate, machine-beveled ends of Ladish Seamless Welding Fittings. Rigid metallurgical controls—evidenced by the Ladish heat code—safeguard against impurities such as slag and sulphur, thereby assuring the uniform weldability of every Ladish Fitting.

FLEXIBILITY IN PIPING DESIGN

Ladish Seamless Welding Fittings offer the thrift that goes with complete flexibility in piping system design.

True circularity permits cutting odd-angle sections for special piping makeup . . . while geometric accuracy facilitates economical prefabrication of large, complicated sections on the ground with assurance that they will fit perfectly into the system.



EASY, ECONOMICAL INSULATION

As easily covered as the pipe itself, Ladish Seamless Welding Fittings assure important savings in erection costs by simplifying the application of insulation. Smooth, unbroken surfaces require no special treatment to increase application costs. Since their welded joints are permanent, no provision is necessary for removal of insulation to inspect, repair or tighten joints.

Controlled Quality FITTINGS

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

DISTRICT OFFICES:
New York • Buffalo • Pittsburgh • Cleveland • Chicago • St. Louis • Atlanta • Houston • Los Angeles

Only Sloan

can say this:

63% OF ALL HOTELS* ARE SLOAN EQUIPPED—

90% OF THESE ARE EXCLUSIVELY SLOAN!

There are several reasons for Sloan's pre-eminence. For one thing, maintenance costs are reported as low as ¼ of 1c per valve *per year.* Then, too, Sloan Flush Valves save water; they protect public health by preventing back syphonage; they can now be whisper quiet; they have unlimited life—yet cost no more. That is why more Sloan Flush Valves are sold than all other makes combined.

SLOAN VALVE COMPANY • 4300 W. Lake St., Chicago, Ill.

**Hotels of 100 rooms or more.*

sloan *Flush* valves

YES —ALL these benefits in Fairbanks-Morse Diesels

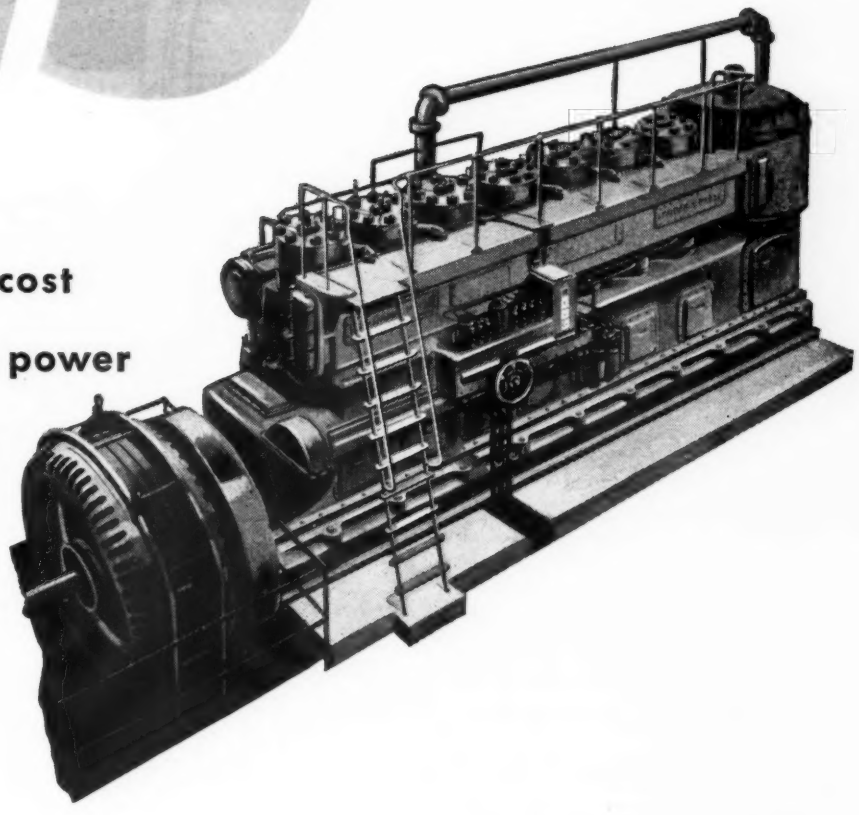
low fuel cost

low maintenance cost

maximum reserve power

sustained, heavy-duty operation

economical stand-by service



TODAY, more than ever before, you want diesels that will give you a combination of all these benefits. Fairbanks-Morse Diesels will—as proved again and again by actual performance records in every field of industry.

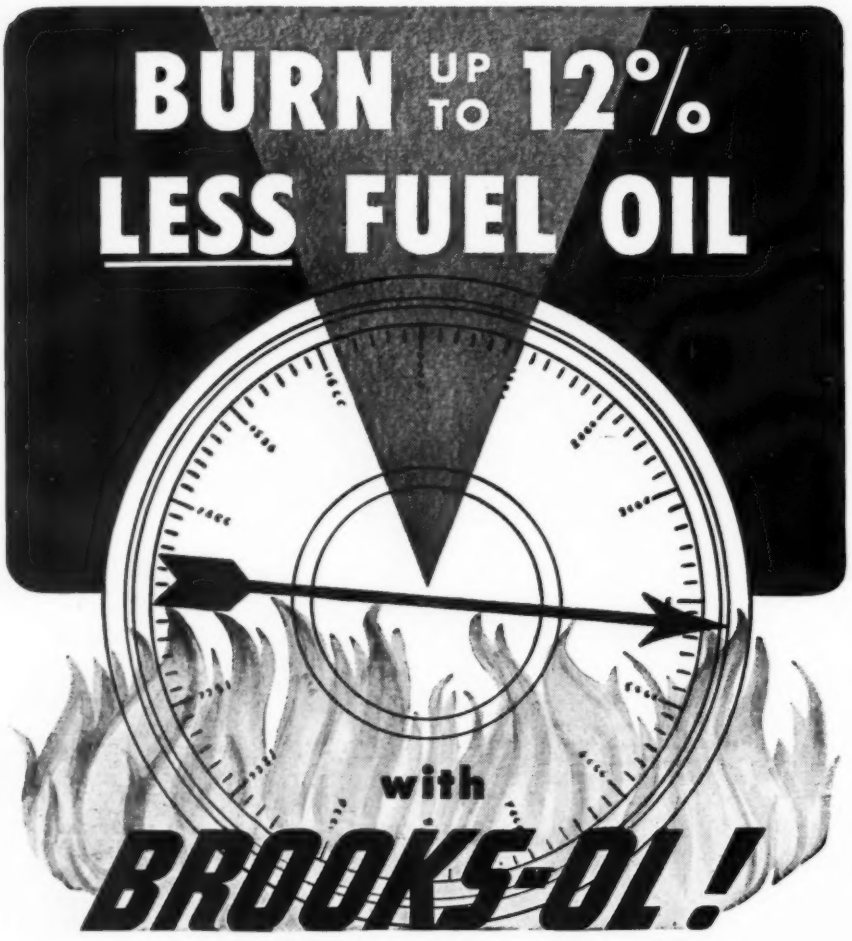
These same records prove, too, that Fairbanks-Morse Diesels continue to give users all of these benefits, year after year. Time and time again they have paid for themselves in a surprisingly short time, through their power cost savings—only to go on saving their owners money for many years thereafter.

Surely, this is the kind of diesel performance you want—and surely, this is the kind of diesel performance you will have with Fairbanks-Morse Diesels. Too, they help conserve vital fuel oil supplies, because diesels generate more power than any other oil-burning power producer. Write today for further information about them. Fairbanks, Morse & Co., Chicago 5, Ill.

Fairbanks-Morse

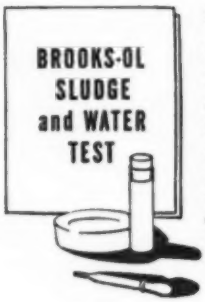
A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps • Scales
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment



New kind of fuel oil additive *ends sludge,* too!

BROOKS-OL, the *new* chemical fuel oil additive, eliminates sludge by reducing fuel oil viscosity, breaking up emulsions and separating excessive amounts of water from oil. Increased liberation of B. T. U.'s per pound of oil thus lowers consumption by as much as 8% to 12%! Used by leading industrial firms throughout the country.



SEND FOR BROOKS-OL TEST KIT!

Make this test yourself! Give the BROOKS-OL Sludge and Water Test to sludge *from your own fuel oil tank.* It takes only a few minutes. Before your eyes, BROOKS-OL dissolves sludge, breaks up emulsions—*fast!* We'll send you a kit along with complete instructions. Just request the BROOKS-OL Test Kit on your own company stationery. No obligation. Write today . . . save fuel and you save money!

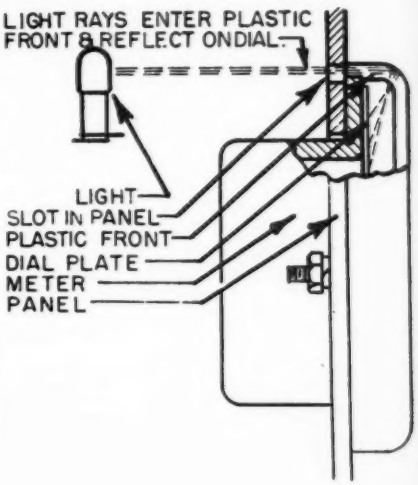
SINCE B 1876

THE BROOKS BOILER TREATMENT COMPANY

3304 East 87th Street, Cleveland 4, Ohio

BOILER METAL TREATMENT • WATER TREATMENT • ZEOLITE SOFTENER TREATMENT • BRINE TREATMENT • WATER CONDITIONER • CONDENSER AND COOLING WATER TREATMENT FURNACE SOOT AND CARBON REMOVER • BOILER RUST AND CORROSION REMOVER • ASBESTOS ROOF COATING

from 200 to 700 hp at 3600 rpm with NEMA Class B starting (normal torque, low current) this motor is favorable for across-the-line starting. It is built of dripproof construction using a fabricated-steel frame. The motor is engineered to meet exacting requirements for high-speed service and has the *Kolene* process centrifugal cast bearing sleeves. Pressure-lubricated bearings are also available, and split-bearing bracket doweled to permit easy access. Windage noise is lessened by design to avoid abrupt acceleration of air. Rotor squirrel-cage winding has *Phos-copper* braze welding at all joints. **Electric Machinery Mfg Co. Minneapolis 13, Minn.**



Illuminated Meters E63

NEW PLASTIC METERS direct light from rear illumination through clear plastic and diffuse it over the front and dial. Light bulb is mounted outside the meter case, far enough away so that any heat will not affect the instrument. Size and type of light bulb are determined by amount of light desired, and the mounting that is most convenient. Model 352 for ac and 351 for dc are 3¾ in. rectangular shape. **Assembly Products, Inc, Chagrin Falls, Ohio.**

Tool Hose E64

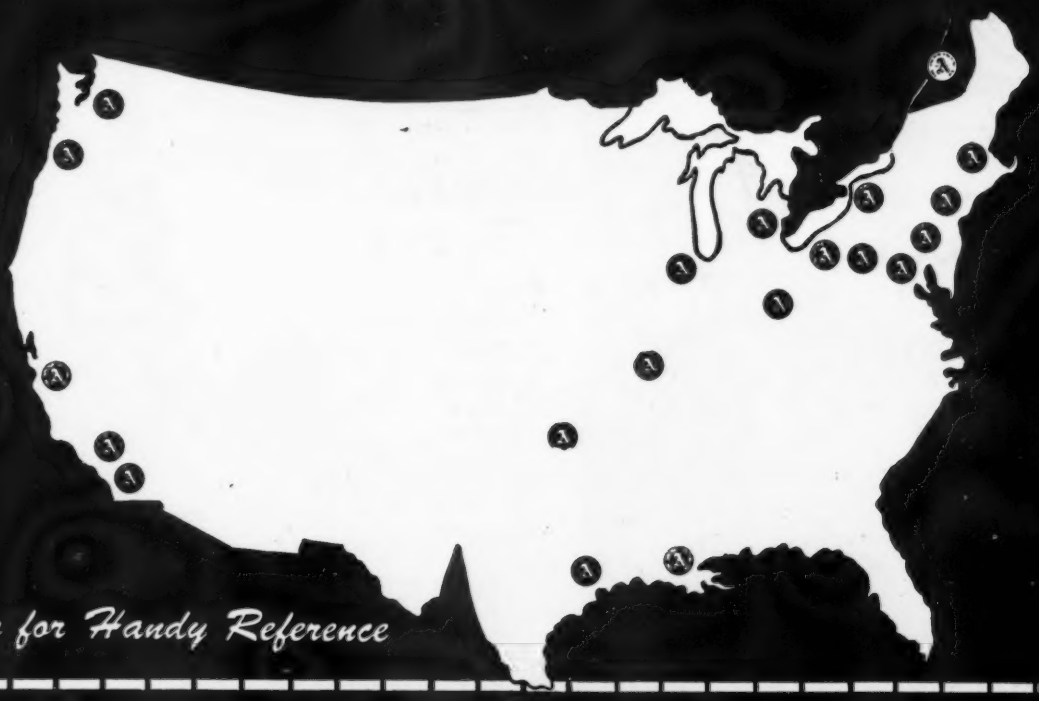
RAY-MAN LIGHTWEIGHT HOSE with rayon-strength members is available for bench work with small air-operated tools where ordinary air hose is too heavy and cumbersome. The manufacturer says the hose has great strength and flexibility. It comes in an oilproof type made with oil-resisting rubber in sizes from ¼ to ½ in. **Manhattan Rubber Div, Raybestos-Manhattan Inc, Passaic, N. J.**

Tachometer Head E65

SPEEDS FROM 1 TO 100,000 RPM can be measured by direct coupling with Metron Type 53 tachometer head used with the company's electric tachometer indicators. Direct linear speed measurements are feasible down to a fraction of a ft per min.

THERE'S AN ANCHOR PACKING COMPANY BRANCH NEARBY TO GIVE YOU QUICK SERVICE

Located throughout the United States are Anchor branches carrying complete stocks of all our products. We call this widespread distribution to your attention, and suggest you file the list for easy reference the next time you wish to consult us on any mechanical packing problem.



Clip for Handy Reference

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509 Washington Avenue	Houston 2, Texas
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5575 Cote St. Paul Road	Montreal 20, Canada
418 Common Street	New Orleans 4, Louisiana
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405 Penn Avenue	Pittsburgh 22, Pennsylvania
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This ASME Stamp on ADSCO HEAT EXCHANGERS

IS JUST ONE EXAMPLE OF OUR *Qualifications*

● ADSCO Heat Exchangers are designed and built to conform to the highest standards.

Modern facilities and qualified welders assure the excellence of ADSCO Products whether built under the ASME Code or for the rigid requirements of the U. S. Bureau of Navigation and Steamboat Inspection, American Bureau of Shipping, U. S. Navy and U. S. Army.

Write for Bulletins No. 35-75 and 35-76 on ADSCO Storage and Instantaneous Water Heaters, or give us details of your heat exchanger requirements for quotation.

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.

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WYOMING
Casper 1656

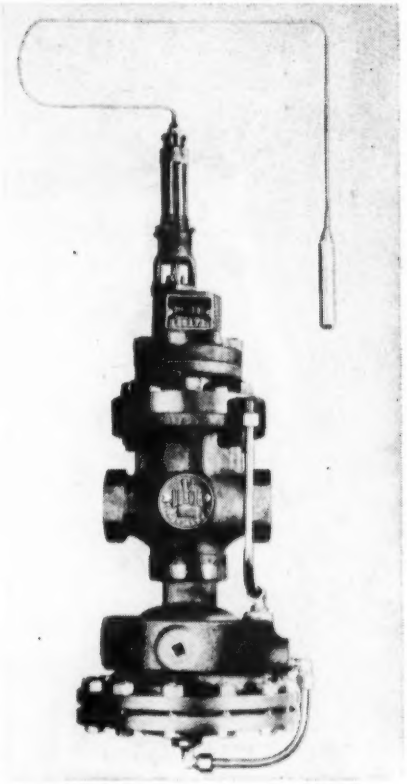
ONTARIO, CANADA
Toronto Rand 3166

QUEBEC, CANADA
Montreal Lanc. 1823

HAWAII
Honolulu P.O. Box 2755

PUERTO RICO
San Juan 2-8475

Type 53 tachometer head can be operated in any position. Indicator connections are made through ¼ in. conduit to inside terminals accessible by cover plate on the rear. Dimensions are 3¾ in. high, 2½ in. wide and 5¾ in. long. **Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.**



Temperature Regulator E66

SELF-ACTING TEMPERATURE REGULATOR designated as Class *T* is of single-seated construction in all sizes from ½ to 4 in. for steam pressures up to 125 psi. It uses packless main valve stem, hard-faced seating surface and hard wearing parts and liquid-filled thermostatic element. Sizes available are ½ to 4 in., inclusive, for steam pressures up to 125 psi (175 psi liquid), and temperatures to 450 F. **Leslie Co, 50 Delafield Ave, Lyndhurst, N. J.**

Pressure Control E67

AEROTEC H-701 PRESSURE CONTROL provides accurately calibrated visible scale for easy adjustment in a range of 1 to 15 psi, and a differential of 1 to 5 psi. It is available with 10 amp, 110 v; or 5 amp, 220 v; single pole, single or double throw, normally open or normally closed contacts. Underwriters approved for ½-hp. rating. Dimensions are 3⅝x3⅝x2½ in. **Thermix Corp, Greenwich, Conn.**

Portable Electrical Cords E68

FEATURING A HEAVY-DUTY *Neoprene* rubber jacket to provide increased protection against abrasion and damage, this electrical cord has a new jacket, 30 to 60% thicker without increase in over-all diameter of

Whatever Your Piping Needs . . .

SHAW

fills them quickly—dependably

KNOWN SINCE 1893 FOR HIGH QUALITY

dependable

PIPING

prefabrication and installation

Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping—any place in the United States and Canada.

President

BENJAMIN F. SHAW COMPANY — 2ND & LOMBARD STS., WILMINGTON 99, DEL.

LUBRIPLATE maintains a durable, load carrying film at the "Friction Point," which reduces friction, retards progressive wear and prevents rust and corrosion. That is why gears lubricated with LUBRIPLATE last longer and run better. Don't take our word for it. Prove it to yourself. Thousands have in every industry.

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Lubricants definitely reduce friction and wear to a minimum. They lower power costs and prolong the life of equipment to an infinitely greater degree. LUBRIPLATE arrests progressive wear.

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Lubricants protect machine parts against the destructive action of rust and corrosion. This feature alone puts LUBRIPLATE far out in front of conventional lubricants.

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Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

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FISKE BROTHERS REFINING CO.

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DEALERS FROM COAST TO COAST
CONSULT YOUR CLASSIFIED TELEPHONE BOOK

cord. This is made possible by *Laytex* insulation on individual conductors within cord. *Laytex* is applied by a dipping process that produces a thinner insulation with superior physical and electrical properties. Called *Master Cords*, these cables range in size from No. 10 AWG to No. 18 with two, three or four conductors with or without steel-wire reinforcement.

This cord withstands extreme flexing, constant movement and surface abuse. It is intended for service on all kinds of portable electrical equipment. **United States Rubber Co, Rockefeller Center, New York, N. Y.**

Wire Marker E69

MOUNTED ON TWO SELF-STARTER STRIPS, standard *Quik-Label* cards have one row of 1½-in.-long labels. A new feature is that labels also come cut in half, thus making two rows of ¾-in.-long labels. *Quik-Labels* are plastic coated so dirt and grease won't smear the figures. They are mounted on self-starter strips that partly peel each label automatically. An entire electrical system can be coded correctly and uniformly in accordance with authentic, approved codes. Labels go all around the wire, thus showing number or color from any direction. The two sizes make label installation quick and easy, as well as providing sizes for both large and small wires. **W H Brady Co, 815 N 3rd St, Milwaukee 3, Wis.**

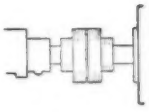
Rubber-Spring Mounting E70

LOW IN COST, this vibration control unit, Type *RS*, has a high-load capacity, ranging from 25 to 125 lb per unit. A conical-spring design provides greater horizontal stability than conventional all-rubber mountings. This means smoother operation, particularly during starting, and frequently eliminates the necessity for snubbers or flexible connections.

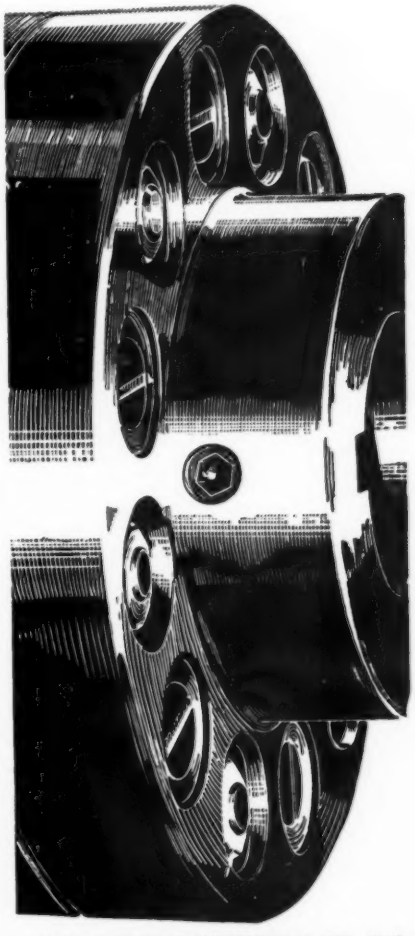
This combined use of rubber and steel springs not only increases the load capacity, but also gives Type *RS* a wide frequency range for successful isolation.

AJAX

FLEXIBLE COUPLINGS



● The fact that *all the horsepower* goes *through the coupling* emphasizes the *importance* of protecting direct-connected machines against misalignment. Write for the Ajax Coupling data book or phone the Ajax man in your territory.



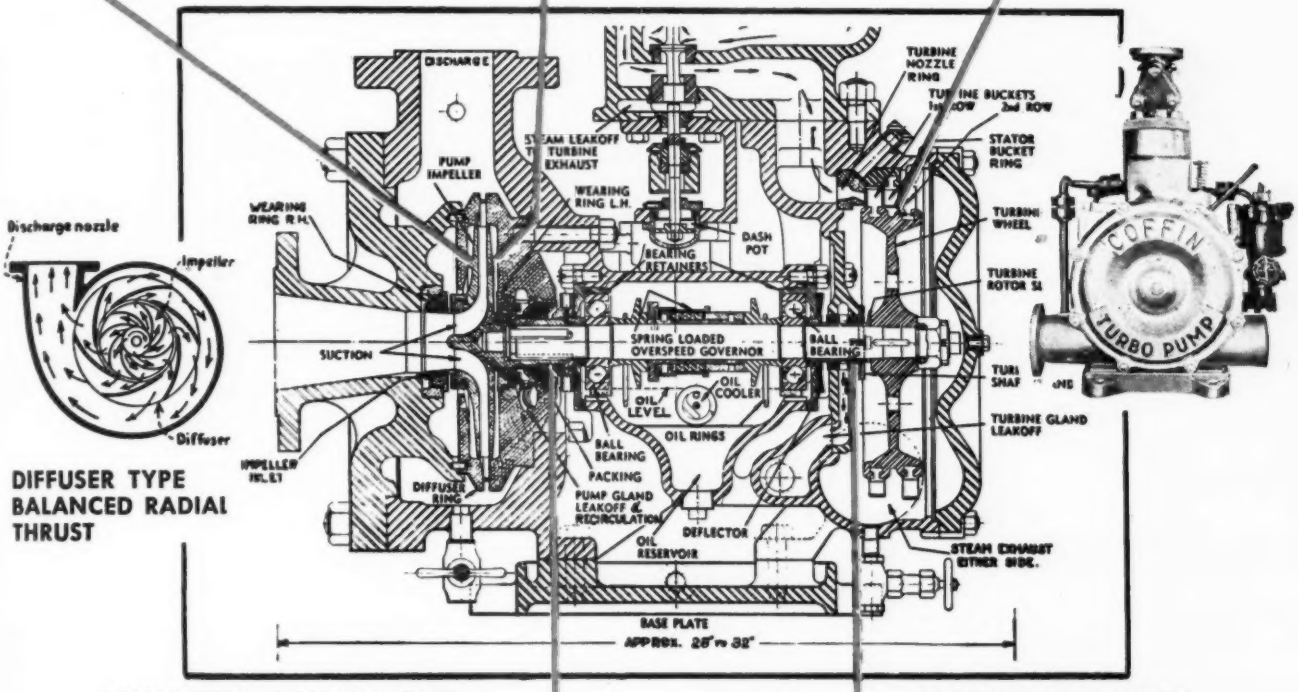
AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, NEW YORK

COFFIN TURBO PUMPS

HIGH SPEED • SINGLE STAGE

HIGH PRESSURE AXIAL THRUST . . . INTEGRALLY FULLY BALANCED
(Equal impeller shroud projected areas X high pressure)

NEGLIGIBLE AXIAL THRUST HERE



DIFFUSER TYPE BALANCED RADIAL THRUST

LOW PRESSURE AXIAL THRUST . . . NEARLY BALANCED . . . SMALL RESIDUAL THRUST · · · · · ·→
(Suction pressure X pump gland area)

←—— COMPENSATING SMALL AXIAL THRUST
(Exhaust pressure X turbine gland area)

— 8 —

Exact Hydraulic Balance . . . .

. . . without floating balancing devices and regardless of loss of suction or "flashing."

Bearing Troubles Minimized

Standardized Boiler Feed Units for:

Steam Pressures to 650 PSI
Steam Temperatures to 850 F
Back Pressures to 60 PSI

Pump Capacities to 500 GPM
Discharge Pressures to 750 PSI (Heads to 1800 feet)
Liquid Temperatures to 300 F

UNIQUE FEATURES

1. Standardized Steam Turbine Centrifugal Pump and Governor Sets, individually engineered, assembled, and tested . . . for IMMEDIATE SHIPMENT.
2. No destructive casing erosion-corrosion.
3. No interstage leakage.
4. Wide range exact pressure governing.
5. Loss of suction reduces speed without tripping; automatic speed recovery with suction restoration.
6. High efficiency pump plus high speed two-bucket row turbine result in minimum steam consumption.
7. Matched Pump, Turbine and Governors under one responsibility.
8. Exact hydraulic and mechanical balance—light weight rotor—large bearings; result: bearing troubles practically unknown.
9. Pump Gland Leakoff provides adequate recirculation; suction pressure only on packing.
10. Rigid one-piece steel casing plus heavy shaft plus ample clearances result in no damage from dry operation.
11. All parts made to gage and replaceable without fitting; all parts in stock at factory with wearing parts available from agencies' stocks.
12. Proved for performance over a period of more than twenty years in service.
13. Compact, light in weight, quiet and low in maintenance.

Literature sent on request; specific proposals on receipt of operating data.

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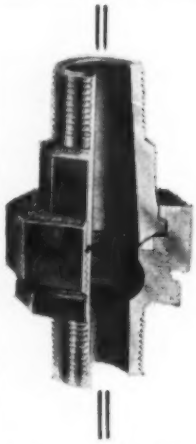

are easier to make up and tighter in service . . . . . because of the exclusive

RECESSED BRASS SEAT

The Jefferson All Male Union illustrated—ideal for such an installation as that between a check valve and a globe valve having female threaded parts—is typical of the complete line offered by Jefferson for facilitating piping installations. Not only are pipe joints saved, but better, tighter, more easily made up piping jobs are assured.

All Jefferson Unions offer the exclusive Recessed Brass Seat—a construction which gives a drop-tight joint, unrestricted flow and absolute protection from contact with screwed in pipe ends.

Jefferson Specialty Unions are made in 90° and 45° Elbows and in Union Tees.

Ask your distributor for details—or write us direct.

JEFFERSON UNION CO.

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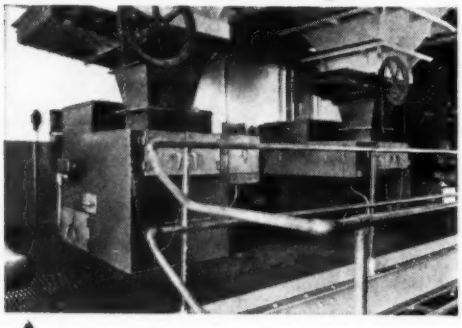
LEXINGTON 73, MASS. LOCKPORT, N. Y.

keep check on boiler efficiency FOR TOPS in fuel economy



WEIGH *all coal accurately on Richardson Automatic Coal Scales*

Richardson Stationary, Floor-Mounted, Automatic Coal Scales supplying two pulverizers for a single boiler. Note access platform between scales of this right-hand and left-hand installation.

Present uncertainty in supply and cost of coal makes it economically vital for boiler operators to keep a constant check on fuel consumption. Regular determination of exact steam generation per-boiler-per-pound-of-coal should be maintained. Richardson Automatic Coal Scales provide this essential "coal-control" with continuous accuracy and dependability.

Availability for floor-mounting (as illustrated), for portable or stationary support at mid-section, or in elongated type scale-conveyor combinations, Richardson Automatic Coal Scales effectively meet specific capacity requirements and plant layouts.

Take no chances on costly, wasteful consumption of coal—have a Richardson Scale check up on boiler efficiencies. Write for Bulletin No. 1143.

RICHARDSON SCALE COMPANY, Clifton, N. J.

ATLANTA, BOSTON, BUFFALO, CHICAGO, MINNEAPOLIS, WICHITA, NEW YORK, OMAHA, PHILADELPHIA, SAN FRANCISCO, DETROIT, PITTSBURGH, MONTREAL, TORONTO

It is as effective for pumps operating at 1750 rpm as it is for compressors running at 450 rpm. They are designed primarily for use on compressors, generator sets, motor-generators, pumps, motors, fans and other machinery requiring a highly efficient, economical, standardized vibration isolator. **Korfund Co, 43-39 32nd Place, Long Island City, N. Y.**

Acid Pump E71

A MANUALLY OPERATED acid pump safely handles liquids from carboys, drums or barrels. Corrosive and other liquids flow smoothly and stop when pump stops. Liquid contacts only corrosion-resistant tube and cannot affect other parts. No tilting of container necessary, reduces to minimum danger of slip, splash or spill.

Pumps are hand or foot operated. Either type can have a lead tube for sulphuric, hydrochloric, hydrofluoric and similar acids or with a flexible-plastic tube for nitric, phosphoric and acetic acids, peroxide, and many other liquids. **General Scientific Co, 27th & Huntington St. Philadelphia 32, Pa.**

Solderless Connectors E72

OVER 30 DIFFERENT SOLDERLESS CONNECTORS for wire sizes from *No.* 12 *AWG* to 2,000,000 cir mil are now offered with a special *Cadux* plating, which makes them suitable for aluminum building wire connections. These new connectors are said to assure positive connections on aluminum, and eliminate normal electrolytic action that usually takes place between copper and aluminum. **O Z Electrical Mfg Co, 262 Bond St, Brooklyn 2, N. Y.**

Precision Switch E73

TWO MAINTAINED CONTACT SWITCHES are designed for services requiring compactness and accuracy of a precision snap-action switch, combined with a latch-out or latch-in feature. In these switches the circuit established by momentary force is maintained until a restoring force is provided.

CONFIDENCE... how much is it worth?

IT WAS NINE YEARS before the first gasoline-driven automobile in the United States was operated by C. E. Duryea that the Brooklyn Bridge was opened in 1883. This fabulous engineering achievement was the culmination of over 26 years of planning and building, of bold vision and heart-breaking struggle, by John A. Roebling and his son Washington.

But the steadfast confidence of father and son in the success of their amazing venture is vindicated daily by the modern traffic this world-famous bridge continues to carry now . . . 64 years later.

How much is that confidence worth to you today . . . and to the John A. Roebling's Sons Company, now embarked on a multi-million dollar expansion program to meet the future's challenge?

Confidence is the driving power behind our efforts to make better products do better work for you.

You Can't Go Wrong—If You Use the Right "Blue Center" Rope

There's no better way to save wire rope dollars than to use the right rope for your job. That means the right grade of steel, the correct construction, the proper size. And your choice is easy when you specify Roebling "Blue Center" Steel Wire Rope.

In "Blue Center" you get what we feel sure is the finest rope steel made. Secondly, you have a wide range of constructions and sizes to choose from . . . in both preformed and non-preformed types.

Why not make the Roebling Field Engineer your right-hand man in selecting wire rope that will give you peak performance at the lowest overall cost? You can call or write him at our nearest branch office.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

The *RIGHT* steel . . .
The *RIGHT* construction . . .
The *RIGHT* size . . .
—FOR YOUR JOB!

Manufacturers of Wire Rope and Strand • Fittings • Slings • Screen, Hardware and Industrial Wire Cloth • Aerial Wire Rope Systems • Hard, Annealed or Tempered High and Low Carbon Fine and Specialty Wire, Flat Wire, Cold Rolled Strip and Cold Rolled Spring Steel • Ski Lifts • Electrical Wire and Cable • Suspension Bridges and Cables • Aircord, Aircord Terminals and Air Controls • Lawn Mowers

ROEBLING

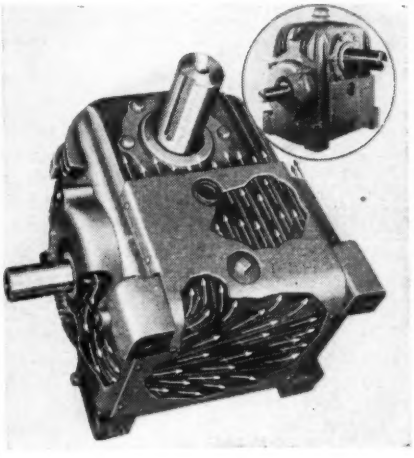
A CENTURY OF CONFIDENCE

Style O Unimax is for service where initiating and restoring forces are applied in same direction. *Style U* Unimax is used where operating forces travel in opposite directions and has the reset button extending through base of switch. Unimax switches carry the regular electrical ratings of 15 amp, 125 v; 5 amp, 250 v; and ½ hp at 115-460 v. All ratings are for 60 cycles ac. *Style O* is for *SPST* service and *Style U* is for *SPDT*. Both units are listed by Underwriters Laboratories, Inc. **Unimax Switch Corp, 460 W 34th St, New York 1, N. Y.**

Glass Capacitor Bushings E74

POWER-FACTOR CAPACITORS now use cast-glass bushings with integral hardware, which permit a permanent hermetically sealed unit. The bushings are made of exceptionally stable low-expansion glass in which special nickel-steel alloy inserts are cast. The thermal expansion characteristics of the alloy are coordinated with those of the glass. A metal mounting flange cap is fused directly to the glass and the flange is in turn soldered to capacitor case, thus forming a hermetic seal that is permanently moisturetight.

According to GE engineers, the glass bushings are practically unaffected by weather, micro organisms and thermal shocks. When high voltage or impulses are applied the bushings flash over externally rather than puncturing or shattering. They are equipped with a split-type solderless connector. **General Electric Co, Schenectady 5, N. Y.**



Fan-Cooled Speed Reducers E75

FAN-COOLED CONE-DRIVE speed reducers have removable shields that direct fan-impelled air over finned portion of housing to equalize air flow to all parts of housing that require cooling. Fins are located and shaped to guide air streams for high cooling efficiency. Removing air shields makes housing accessible for cleaning. Impeller and shields may be removed if it is desirable to operate without them. Horsepower rating at 1750-rpm input speed for ratios of 5:1 are 19.8, 37.0, 59.1 and 16.2 **Michigan Tool Co, 7171 E McNichols Road, Detroit 12, Mich.**

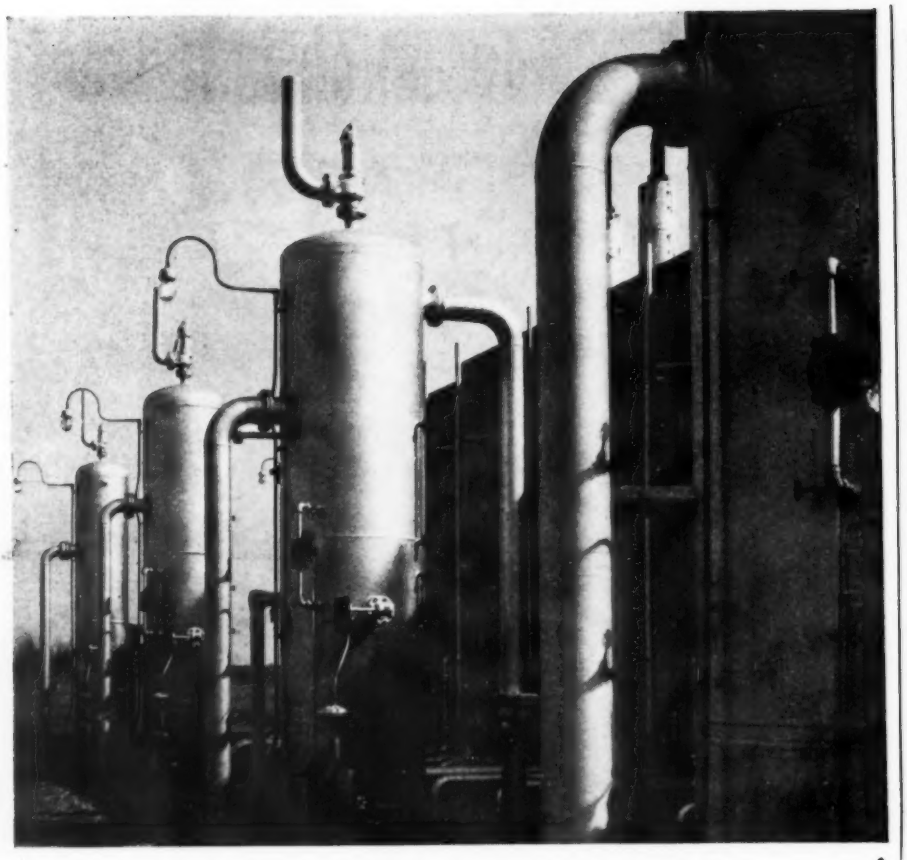


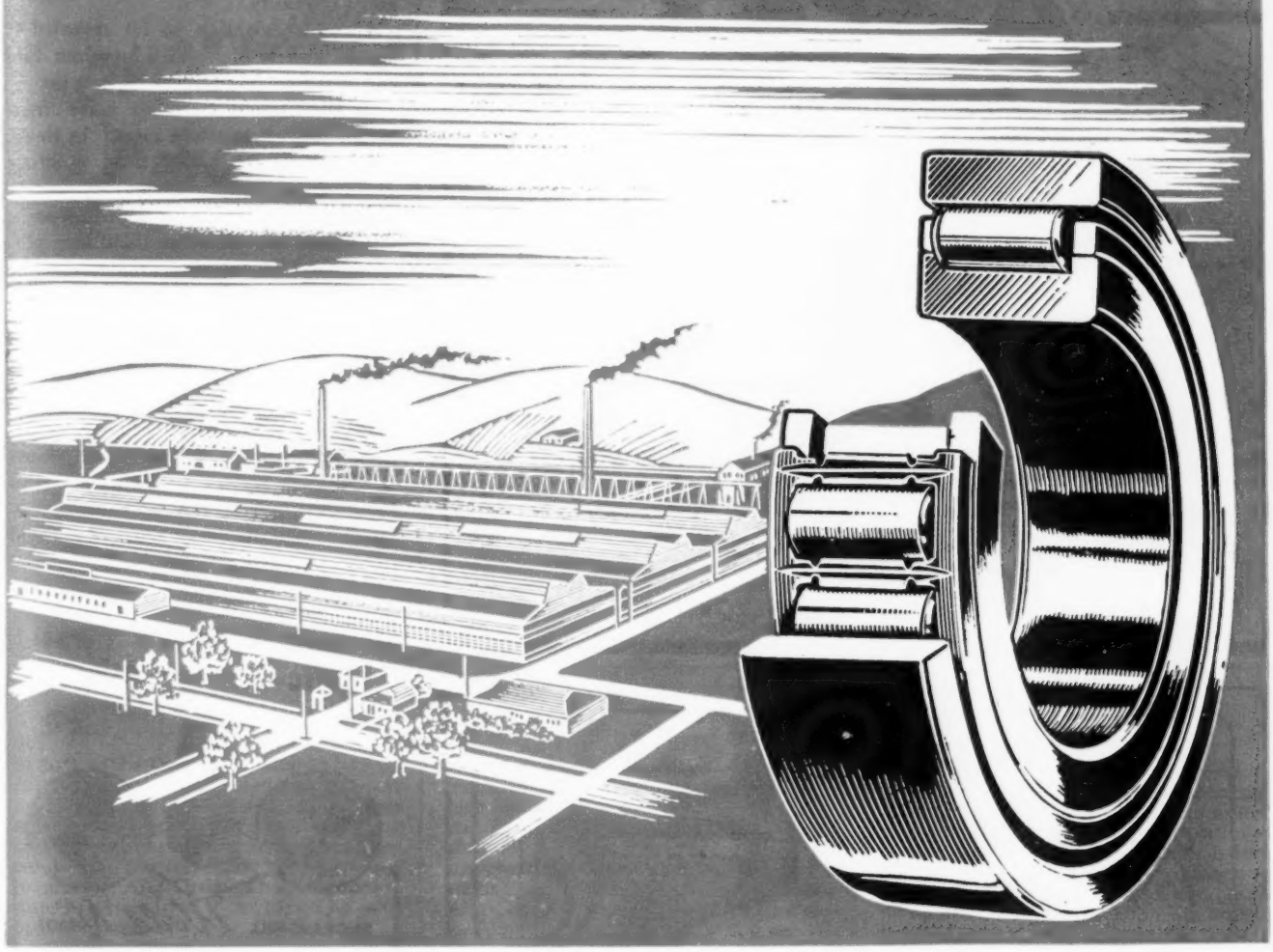
PHOTO SHOWS LIQUID LEVEL CONTROL INSTALLATIONS

Mercoid Controls
on the
Highways and Byways
of
Industry

Designed to automatically regulate electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement. Equipped exclusively with corrosion-proof mercury switches. Various types of mercury switches available to the trade. Further information upon request.

THE MERCOID CORPORATION • 4201 BELMONT AVE., CHICAGO, ILL.
Manufacturers of dependable automatic controls for a quarter of a century

MAKE TYCOL ENGINEERED LUBRICATION A WORKING PARTNER



for increased production... lower operating costs

TYCOL
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TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE • NEW YORK 4, N. Y.

For increased production . . . top efficiency . . . lower operating cost, give your machines superb lubricants – Tycol *Engineered* oils and greases. Tycol lubricants are made to meet every lubrication need of industry – from roll neck greases for steel mills to spindle oils.

Each Tycol lubricant is *scientifically engineered* to meet specific service conditions. In every step, from selection of crudes to blending of the finished product, Tycol lubricants are processed to provide maximum lubricating efficiency which means greater economy, longer machine life for every type of equipment.

Tide Water Associated engineers are thoroughly experienced in all phases of industrial lubrication. Let them help you in selecting the Tycol lubricant best suited to your specific need. Write, or wire your nearest Tide Water Associated Office for complete information.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

The PACKING for LONG SERVICE

ALLPAX

ALLPAX is the packing that won't let you down when temperatures go up or when you are looking for long, care-free service from your equipment. One of the reasons for the long-wearing service of ALLPAX is that it remains perfectly dry while holding its lubricant regardless of pressure or temperature. Its long asbestos fibres prevent the molded ALLPAX from amalgamating into a dense metallic mass, but keep it bonded together in a resilient packing that retains its springiness even after long service. This resiliency makes ALLPAX leak-proof without excessive pressure. The lubricant in ALLPAX cannot be forced out regardless of pressure, and a perfect film is maintained between packing and shaft at all times.

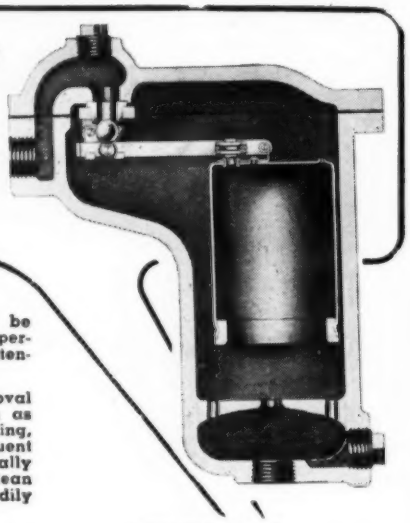
Try ALLPAX and prove its advantages in long service.

ALLPAX distributors are all around you. Get in touch with yours and ask him to supply your requirements.

THE ALLPAX CO., INC.

MAMARONECK, NEW YORK

Specify "CRYER" *and put an end to trap troubles*



The experience of Cryer Trap users can be summed up in a few words: trouble-free performance year after year with minimum attention.

Cryer Traps have won unqualified approval because design and construction are such as to eliminate air binding, dribbling, sticking, slow venting and the necessity for frequent cleaning. As one user puts it, "They really operate." And when it is necessary to clean or inspect a "Cryer," all parts are readily accessible.

The troubles so often associated with steam traps just don't come up with "Cryers" on the lines. We'll be glad to submit substantiating proof of this statement from the actual performance of Cryer Steam Traps in the hands of their users. As a matter of fact, performance is guaranteed. Ask for complete details.

Also Thermostatic Radiator Traps, as well as all sizes of traps and repair parts for the line formerly known as the J-M Ball Steam Trap.

Sizes: ½" to 2½"
Capacities: 500 to 38,000 lbs. of water.
Pressures: to 250 lbs.

Manufacturers of Steam Specialties for over 40 years.

CRYER TRAP & VALVE CO., INC.

366 Madison Ave. New York, 17, N. Y.

Power News

(*Continued from page* 138)

pile physics. It may be years before advancing scientific and engineering knowledge makes atomic power a commercial reality.

From information so far revealed it would appear that the plutonium fuel for a small high-intensity reactor of this sort would have to come from larger natural-uranium piles. In these, some of the neutrons from splitting U235 atoms split other U235 atoms. Many of the remaining neutrons serve to convert the plentiful U238 into plutonium. This was the process used at Hanford to make plutonium for the Bikini atomic bombs.

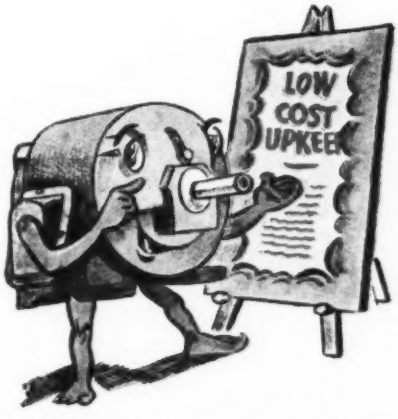
The use of concentrated plutonium points the way to future small-sized piles suitable for certain type of mobile plants—for example, power plants for ships and manless planes. Such plants will not be used to drive automobiles because of the 50 tons of shielding required. In large ships shielding would not be difficult to carry.

Britain Sets Up First Atomic-Energy Plant

LONDON: Britain's first atomic-energy plant will soon be set up at Sellafield, Westcumberland, on the west coast of England, in a relatively isolated location in the Lake District.

The plant is intended primarily for production of fissionable material in a chain-reacting pile, but may also be used for generation of electricity. Its size is not disclosed for security reasons, but it is not likely to be as large as some premature reports have suggested. These reports have mentioned an electric-generating capacity of as much as 75,000 kw. In any event, the Central Electricity Board, which built a small generating plant at Drigg, just a few miles south of Sellafield, during the war to serve the Royal Ordnance Factories at Drigg and Sellafield, is not at present counting on any electric-generating capacity from this new atomic-energy

"Puzzled over which type of motor to buy?"



In 80% of the Cases, open squirrel-cage induction motors meet the need. They fit most drives, and can be obtained in numerous standard and special designs to meet varying conditions of starting torque, slip, etc. They are also the most economical type to buy and to maintain. Allis-Chalmers builds induction motors in sizes from ½ to 10,000 hp — or higher, if needed.

For Tough Starting Conditions, wound-rotor induction motors are recommended. Their high starting torque, at comparatively low starting current, and their controllable speed characteristics are desirable in drives for conveyors, grinding mills and other tough starting assignments. Compact, accessible Allis-Chalmers wound rotor induction motors range in size from 5 to 10,000 hp.

For Slow Speed, direct-connected drives as low as 75 rpm, or other constant speed applications at higher rpm, synchronous motors are a good solution. They are of particular benefit when a system's power factor is low, since they can be furnished for operation at either unity or leading power factor. From 40 hp to 50,000 hp and higher — in bracket bearing, pedestal bearing, or engine types.

Is d-c Available? Then adjustable speed operation is easily obtainable. Allis-Chalmers builds d-c motors from ½ to 10,000 hp and higher — for constant or adjustable speed duty in ranges of 6:1 and lower. By means of a source of d-c voltage, adjustable speed motors may also be designed to operate over a speed range as high as 30:1. Suitable for fans, elevators, etc.

Select from the Complete Allis-Chalmers Line!

NOT JUST FOLLOWING popular choice and using a standard squirrel cage induction motor. But the *right* motor for economy and efficiency.

That means an overall knowledge of *all* types of motors . . . their operation . . . limitations . . . maintenance. And there's where your A-C representative can be a big help. His recommendations are backed by experience . . . and the Allis-Chalmers motor he selects is *itself* backed by 50 years of experience in motor design and building. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2304

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A CENTURY OF SERVICE to Industry THAT MADE America Great

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment-
Biggest of All in Range of Industrial Products

Easy Way to Remove Slime from Evaporative Condenser Coils

To remove slime and other foreign matter that has accumulated on the coils of your evaporative condensers to impair heat transfer, here is a suggestion that will prove particularly effective.

Make up a recommended solution of Oakite Composition No. 22 and add to the drip pan or sump tank, then circulate solution with water pump until slime has been loosened. Drain tank and flush away slime with clear water rinse. If necessary, spray-heads may be removed and cleaned separately. You will find this simple Oakite treatment a fast, extremely economical way to restore condenser heat transfer efficiency.

On-The-Spot Assistance

Your nearby Oakite Technical Service Representative will gladly lend a hand on this slime-removing operation. Just give him a call. Or write for a copy of Digest giving complete details on this and 70 similar maintenance cleaning tips for power plants. There's no obligation.

OAKITE PRODUCTS, INC.
23 Thames Street, NEW YORK 6, N. Y.
Technical Service Representatives Located in Principal Cities of United States and Canada

OAKITE
REG. U. S. PAT. OFF.

Specialized Industrial Cleaning
MATERIALS • METHODS • SERVICE

plant; moreover the project forms no part of the CEB's huge 5-year expansion scheme.

The Sellafield plant will be erected on the site of the Royal Ordnance Factory where Courtaulds Ltd had intended to erect an acetate-rayon spinning plant. When, several months ago, it became known that the Government was strongly considering using the ROF explosives plant at Drigg for its atomic-energy project, Courtaulds felt there would not be enough labor to build and operate both plants, and agreed to withdraw its own plant from the area. Subsequently, the Sellafield location proved more suitable than Drigg for the atomic-energy plant and its use for industrial purposes was more consistent with the over-all plan for industrial relocation in the area and with proposals for a Lake District National Park, which would incorporate part of the coastline.

Construction work on the new plant is to begin shortly and, says the Ministry of Supply, "will give employment to a considerable number of men for some time to come."

The new plant will be the second link in Great Britain's atomic-energy projects. The first is production of pure uranium from pitchblende concentrates, which is going forward smoothly at Ministry of Supply's own factory at Springfields, near Preston. One consideration in location of the plant for the second stage, production of fissionable material from the uranium, is that it be reasonably near Springfields, and another that it be an already prepared site, to save time.

A day after the announcement of the decision on the site at Sellafield, the Minister of Supply told the House of Commons that Britain's first experimental pile, at the research establishment set up last year at Harwell, Berkshire, would be in operation by the end of this year. Further, the Government hopes to establish at Harwell a university of nuclear fission, second to none in the world.

An appropriation of $5,200,000 for construction of a second unit at the new Lakeside station of Rochester (N. Y.) Gas & Electric Corp has been announced by Edgar A Crofts, operating vice-president. The appropriation will bring to $12,500,000 the cost of the first two units of the new electric-generating station. Erection of the first unit, to cost about $7,300,000, is under way already, but is not expected to be completed for another year. Construction of the second unit will not be started until the spring of 1947. It will have a capacity of 40,000 kw. Aggregate capacity of the new station when its four production units are completed will be 160,000 kw. Total cost will be $20,000,000.

Where there's a PUMP in your Plan
SPECIFY
PEERLESS

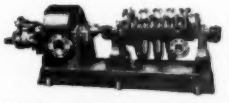
For diversified, continuous duty services in industrial, chemical and process plants, etc. Peerless centrifugal pumps incorporate many proven design features for extended pump life, minimum down-time and operative economy. They are manufactured in an extensive series of advanced types, sizes and capacities up to 70,000 G. P. M.

TYPE A
General Service Pump

Peerless type A pumps afford top-flight, continuous duty operation with capacities from 50 to 70,000 g.p.m. Heads: 15 to 300 ft. All types of drives: 1 to 1000 h.p. Sizes: 2" to 42" discharge. Split-case, single stage, double suction type.

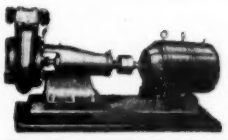
TYPE AF
Fire Pump

Peerless Underwriters' Approved fire pumps are available for all fire protection services. Capacities: 500 to 2000 g.p.m. Pressures: to 150 lbs. single and double stage types, for electric, engine, turbine drive or combinations.



TYPE B
Boiler Feed Pump

Peerless Type B multi-stage pumps are designed for boiler-feed, pipe line and refinery services delivering capacities up to 900 g.p.m. against pressures up to 700 lbs. For electric and other type drives from 60 to 350 h.p.



TYPE DS
Process Services Pump

The ideal pump for chemical, oil, soap and similar process services. Capacities: 10 to 1500 g.p.m. Heads: up to 231 feet. Handles a wide variety of corrosive or non-corrosive liquids at temperatures up to 200° F.; pressures to 100 lbs. Single stage, single suction.

PEERLESS PUMP DIVISION • FOOD MACHINERY CORP.

Factories:
Indianapolis, Ind. • Quincy, Ill. • Los Angeles 31, Calif.
District Offices: Canton 2, Ohio; Philadelphia: Suburban Square, Ardmore, Pa.; Atlanta: Rutland Bldg., Decatur, Ga.; Dallas 1, Tex.; Los Angeles 31, Calif.

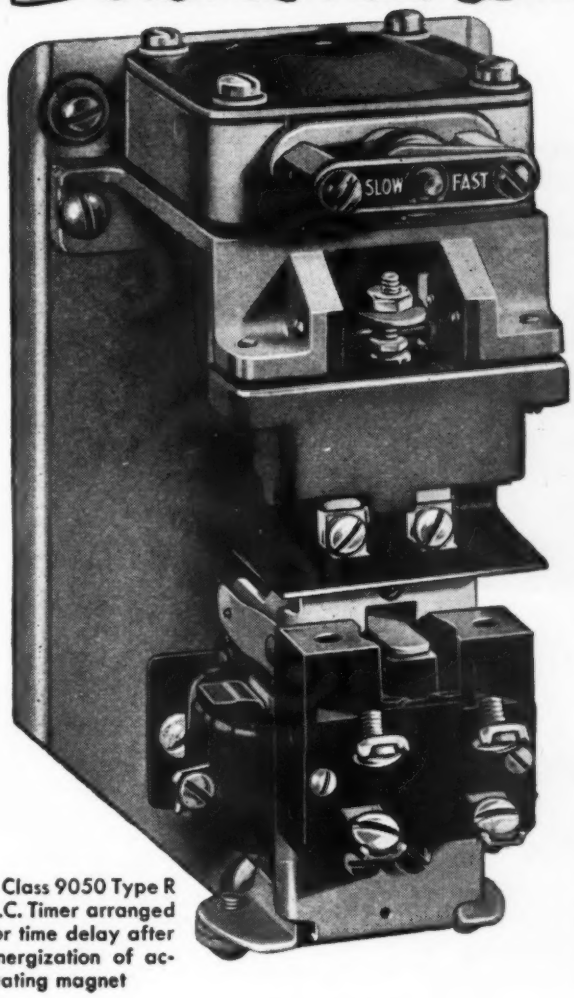
PEERLESS PUMPS
FOR MOST SERVICES IN ALL INDUSTRIES

Better than Ever

PNEUMATIC TIMER

with *New* Contact Mechanism

A.C. and D.C. | WIDE RANGE | ACCURATE | FLEXIBLE | COMPACT | INEXPENSIVE



Class 9050 Type R A.C. Timer arranged for time delay after energization of actuating magnet

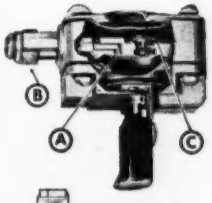
Addition of a heavy-duty, snap-action contact mechanism, with isolated N.O. and N.C. Circuits, to a dependable timing mechanism, improves performance and broadens an already wide range of applications.

For more than ten years Square D's Pneumatic Timer has been used successfully for timing resistance welds, machine tool sequences, process industry operations and scores of other similar functions. Timing is accurate and easily adjustable.

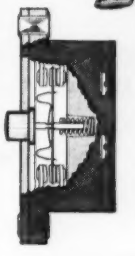
Two kinds of operation—time delay after either *energization* or *deenergization* of actuating magnet—provide for circuit simplification and greater dependability.

Adjustment is by either a knurled knob, or a micrometer mechanism graduated from 0 to 80. Range is 0.2 seconds to 3 minutes, with accuracy better than ±10%.

Auxiliary Circuits operated by actuating magnet usually eliminate need for additional switching relays.



TIMER OPERATION—Simple operating principle is based on the interval required to transfer a small volume of filtered air from upper to lower chamber through a regulated orifice (A). Rotation of knurled knob (B) gives wide range of adjustment. Air returns through valve (C) for instantaneous reset.



CONTACT MECHANISM—Has separate N.O. and N.C. circuits with double-break, silver contacts . . . Simple operating mechanism uses alloy springs separate from heavy contact blade which carries current . . . Stainless steel compression-return spring . . . Enclosed in sturdy case of highly arc-resistant melamine . . . Four No. 6-32 binder head terminal screws.

FEATURES

Simple Knob or
Indicating Micrometer Adjustment
Auxiliary Circuits Operated from Magnet

	CONTACT RATINGS						
	A.C. Voltage				D.C. Voltage		
Electrical Ratings	110	220	440	550	115	230	550
Normal Amperes	15	10	6	5	0.5	0.25	0.05
Inrush Amperes	40	20	10	8	—	—	—

***Write** for Pneumatic Timer Bulletin 9050. Address SQUARE D COMPANY, 4041 North Richards St., Milwaukee 12, Wis.*

SQUARE D COMPANY

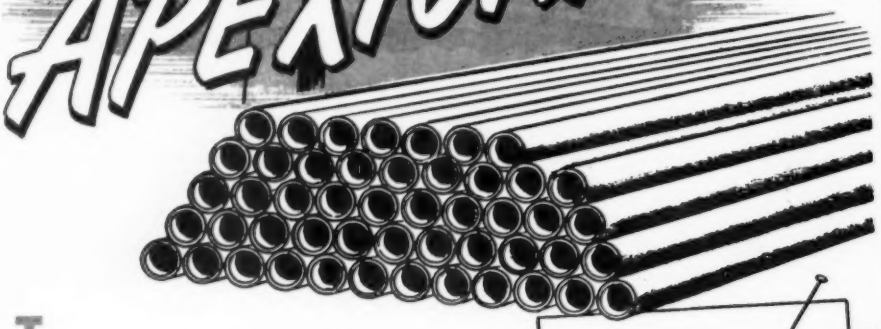
DETROIT • MILWAUKEE • LOS ANGELES

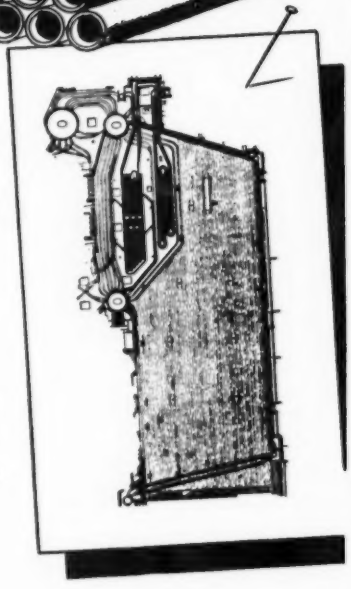
SQUARE D CANADA, LTD., TORONTO, ONTARIO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

59-I-1

ANOTHER 6 MILES

APEXIORIZED





THIS new central-station boiler could have gone on the line with its 32,000 feet of tubes and 89 more of drums bared to steam and water — but it went into service with every inch of those six miles APEXIORized.

For the engineers who designed the plant and the utility that was to operate it recognized protective surfacing as an investment that pays off — knew they could count on APEXIOR NUMBER 1 to bring a boiler off the line new as the day it went on.

New, because APEXIOR gets a boiler off to the right start with pickled tubes and abrasive-blasted drums — metal free from the mill scale that damages valves . . . causes pitting, electrolytic corrosion, or localized overheating — clean surfaces that are an assurance of quality.

APEXIOR maintains that quality throughout the life of the boiler, for it never gives corrosion a start — never allows water or steam to penetrate to the steel beneath — and because it smooths as it seals, repels deposits — never lets them gain a foothold.

That's why APEXIORized metal is an investment in better heat transfer — longer in-service time — less costly cleaning . . . why it can mean so much to your new boiler, or one already on the line.

WRITE US FOR MORE FACTS ABOUT

DAMPNEY *Maintenance for Metal*

The DAMPNEY COMPANY of AMERICA, Hyde Park, Boston 36, Mass.

Pennsylvania State College announces openings are available for appointments of graduate assistants and research assistants in diesel engineering. There may be openings also for regular full-time graduate students in this field, depending upon the number of vacancies in the general student body. Graduate assistants receive stipends of $1000 per 10-month academic year, plus remission of incidental and practicum fees in their major dept. Graduate assistantships require half-time service to the college, but permit the incumbent to register in graduate courses and earn the master's degree in three semesters, or in two semesters and two summers. Research assistantships are of the same academic rank as instructorships and are full-time positions, which permit the incumbent to carry up to six credits of graduate work per semester. Thus the master's degree may be earned in five semesters, or in a shorter period if the summer is spent on research. Bulletin listing available graduate courses may be obtained from *Pennsylvania State College, State College, Pa.*

Work is now in progress on the $1,500,000 LaJoie Falls storage dam for the B C Electric Railway Co. The dam is 40 miles upstream from the Bridge River diversion dam. Contract has been placed with the Northern Construction Co and J W Stewart Ltd. It is estimated that the work will take two years. Upon completion, the dam will resemble a pyramid. It will be 4000 ft long, 240 ft high, and 680 ft wide at the base.

Enterprise Engine & Foundry Co, San Francisco, Calif., has acquired the complete line of Hendy marine and stationary diesel engines, formerly manufactured by Joshua Hendy Iron Works, Sunnydale, Calif.

C H Wheeler Mfg Co, Philadelphia, Pa., announces purchase of marine div of Wm Sellers & Co, of the same city.

The Marion County, Indiana Commissioners and Marion County Tuberculosis Hospital jointly agreed recently to ask federal and state government agencies for an appropriation of $33,000 for planning a new $749,800 powerhouse at the hospital. The powerhouse is to replace the present plant, which is considered dangerous. Total cost of architecture and engineering will be $41,000. Actual building will be deferred until building costs decrease.

In keeping with its established custom of using designers' models to produce better equipment, Allis-Chalmers has built wooden models of steam turbines scaled ⅜ in. to 1 ft to the new standards set forth by American Society of Mechanical Engineers and American Institute of Electrical Engineers.

Use of these models has been found more effective in some respects than drawings as a means of insuring the customer a well-integrated and correctly engineered product. For example, company engineers state that working with models facilitates a better conception of good eye appeal in turbine housings and consideration of the accessibility of equipment arranged in the space below.

Reader Service Page for . . .

NEW EQUIPMENT and TECHNICAL LITERATURE

Use these handy FREE service cards for additional information on this month's new products or for copies of latest trade literature.

NEW PRODUCTS & MATERIALS

See pages 126-130, 140, 166-180

Heating Controller.....page 126
Insulation Tester.....page 126
Lubricating-Oil Refiner.....page 126
Pressure Transmitter.....page 126
Tachometer Indicator.....page 128
Mercury Switches.....page 128
Gage Case.....page 128
Pressure-Seal Valve.....page 128
Fire Extinguisher.....page 128
Safety Flashlight.....page 128
Control Pilot.....page 130
Area Meter.....page 130
Tachometer Head.....page 130
Arc Welders.....page 130
Pipe Threader.....page 130
Balancing Valve.....page 130
Flexible Metal Hose.....page 140
Pipe Packing.....page 140
Cooling Tower.....page 140
Diaphragm Valve.....page 140
Welder Power Unit.....page 140
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Induction Motor.....page 168
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Solderless Connectors.....page 178
Precision Switch.....page 178
Glass Capacitor Bushings.....page 180
Fan-Cooled Speed Reducers.....page 180

MANUFACTURERS' BULLETINS

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Boilers and Auxiliaries.....page 186b
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Maintenance and Safety Equipment.....page 186b
Maintenance Materials.....page 188
Materials Handling.....page 188
Piping, Fittings, Valves and Specialties.....page 188
Other Equipment.....page 190

(Turn over for bulletin items)

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

Example

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AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATING

1 **RADIANT PANEL HEATING**—Revere Copper & Brass Inc, 230 Park Ave, New York 17, N. Y. 38-page booklet gives a nontechnical descriptive introduction to panel heating. This booklet is intended primarily for engineers, architects and heating contractors who seek a background sufficient to enable them to compare radiant panel heating with other heating systems.

2 **PIPE COILS**—Frick Co, Waynesboro, Pa. 6-page bulletin No. 156-C describes Frick VW coils for refrigeration work. Photos show many kinds of Frick coils and welded work. Diagrams are included.

3 **INDUCTION HEATING**—Ajax Electrothermic Corp, Ajax Park, Trenton 5, N. J. 12-page booklet discusses principles of induction heating, advantages, sources of power, furnace controls and auxiliaries, types of induction heaters, typical coils and work stations.

4 **AIR FILTERS**—American Air Filter Co, Louisville 8, Ky. 8-page bulletin No. 210 presents replaceable air filters. Bulletin includes installation data, dimensions and angle details.

BOILERS AND AUXILIARIES

5 **REFRACTORY WALL** — Geo P Reintjes Co, 2515 Jefferson St, Kansas City 10, Mo. 4-page bulletin No. B-547 illustrates, with cross sections and cutaways, construction details of Reintjes tube and tile wall.

6 **WORM-FEED STOKERS**—Brownell Co, 303 N Findlay St, Dayton 1, Ohio. 8-page bulletin No. S-70, second edition, covers Brownell line of worm-feed stokers comprising eleven sizes with capacities of 177 to 1000 lb per hr.

7 **OIL BURNER** — National Airoil Burner Co, 1284 E Sedgley Ave, Philadelphia 34, Pa. 16-page bulletin No. 65 describes operation of Type LAP, Model SC, low air pressure burner. Bulletin also discusses Airovent centrifugal blowers and other company equipment.

CONTROLS, ELECTRIC

8 **REGULATORS**—Spence Engrg Co, Walden, N. Y. 24-page condensed catalog No. 2 gives operating cycle of Spence regulators, main valves, pressure regulators, temperature regulators, strainers. Dimensions and weights, flange standards and capacities are included.

VOLTAGE REGULATOR—Westinghouse Electric Corp, P O Box 868, Pittsburgh 30, Pa. 36-page booklet No. B-3649 explains how Rototrol regulates voltage, speed, current, power, speed and torque, power factor, position, and provides stability and current limiting.

10 **AUTOMATIC SYNCHRONIZER**—Burlington Instrument Co, Burlington, Iowa. 4-page bulletin No. SN-400 gives operation and application of the newly designed Burlington Type SN, Model SF, automatic synchronizer.

ELECTRICAL EQUIPMENT

11 **AIR CIRCUIT BREAKERS**—General Electric Co, Schenectady, N. Y. 32-page booklet No. GET-1113A discusses selection and application of air circuit breakers for low-voltage feeders up to 600 v ac and 250 v dc.

12 **ELECTRICAL CONNECTOR**—Industrial Power & Equipment Co, 406 Millbridge St, Pittsburgh 10, Pa. 2-page bulletin No. 201 describes the R-C-E industrial rubber-clad electrical connector for use where extensions are frequently disconnected.

13 **LOAD-CENTER UNIT SUBSTATIONS**—General Electric Co, Schenectady, N. Y. 32-page booklet No. GEA-3592B tells how load-center unit substations are used, photos and diagrams show a typical load-center distribution system and standard arrangements of circuit combinations.

14 **AIR CIRCUIT BREAKERS**—General Electric Co, Schenectady, N. Y. 16-page bulletin No. GEA-3600 discusses outstanding features of Type AE-1 air circuit breakers. Installation photos are given in this bulletin.

MAINTENANCE AND SAFETY EQUIPMENT

15 **SAFETY TOOLS**—Ampco Metal, Inc, 1745 S 38th St, Milwaukee 4, Wis. 28-page catalog No. 118 shows hand tools for use in hazardous locations. They are nonmagnetic, rustless and corrosion resistant.

16 **INDUSTRIAL HARDWARE**—Thomas Laughlin Co, Portland 6, Me. 32-page catalog No. 140 gives specifications, dimensions, weights, etc, of such drop-forged items as chain links, sling links, shackles, swivels, hooks, wire rope clips, turnbuckles, etc.

17 **FIRE EXTINGUISHERS**—Pyrene Mfg Co, 560 Belmont Ave, Newark 8, N. J. 8-page folder describes cartridge-operated 2½-gal Pyrene water-type and Pyrene antifreeze fire extinguishers.

18 **STEEL-DRUM OPENING TOOL**—Merrill Brothers, 56-02 Arnold Ave, Maspeth, L. I., N. Y. Folder tells how drums can be opened by O'Brien steel keg cutter and transported by Volz positive grip clamp.

19 **SCREW DRIVER**—Eslick Products, Inc, 1312 Hawthorne Ave, Grosse Pointe Woods 30, Mich. 2-page sheet describes a new screw driver, called Slick 3-11, that holds and aligns the screw while driving.

20 **ELECTRIC-IMPACT TOOL** — Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y. 4-page booklet No. 5030 presents the new Size 4U electric-impact tool. This tool applies and removes nuts. It also drills, reams and taps, drives and removes screws, drives and removes studs, extracts broken capscrews and studs, etc.

21 **CABLE TERMINALS** — Macwhyte Co, Kenosha, Wis. 4-page bulletin No. 47-46 describes the Sockatype cable terminals now manufactured by Macwhyte. They were formerly made by Paulsen & Nardon, Inc.

22 **DRAIN CLEANER**—Miller Sewer Rod Co, 4638 N Central Ave, Chicago 30, Ill. 2-page bulletin covers operation of the Miller Rod House for cleaning floor drains, sewers, wash basins, bathtubs, etc. Price list is included.

(*Continued on page* 188)

FIRST CLASS
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(Sec. 510, P.L. & R.)
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"HAS OPERATED 99% OF THE TIME SINCE 1939"

reports the City of St. Mary's, Ohio, of their first 2500 K W Worthington Turbine Generator.

New 2500 KW Worthington Turbine Generator recently installed in municipal power plant of the City of St. Mary's, Ohio.

Mr. George Probst
Worthington Pump and Machinery Corporation
Steam Turbine Division
Wellsville, New York

Dear Mr. Probst:

You will be interested, I'm sure, to learn that our new 2500 KW Worthington Turbine Generator has been running continuously since it was put on the line about six months ago.

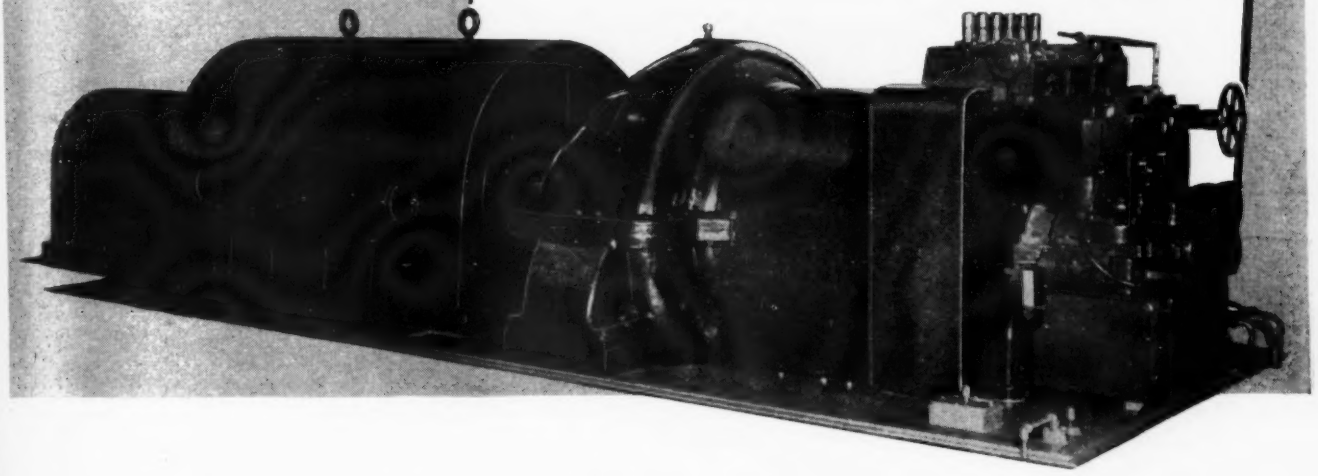
It's been eight years now since our original 2500 KW Worthington unit was started and it has operated 99% of the time ever since. On a number of occasions, it has carried loads of 3000 to 3500 KW for periods of three to four hours. We run both units a large portion of the time and they parallel very nicely.

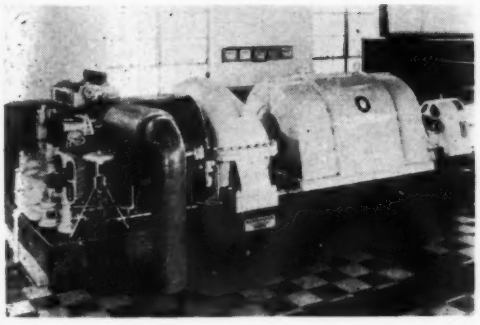
In fact, we do so well with these Worthington units that we would be glad to show them in operation to any of your prospective customers who care to visit our plant.

Very truly yours,
CITY OF ST. MARY'S

J M Hageman

City Engineer and Director
of Service and Safety





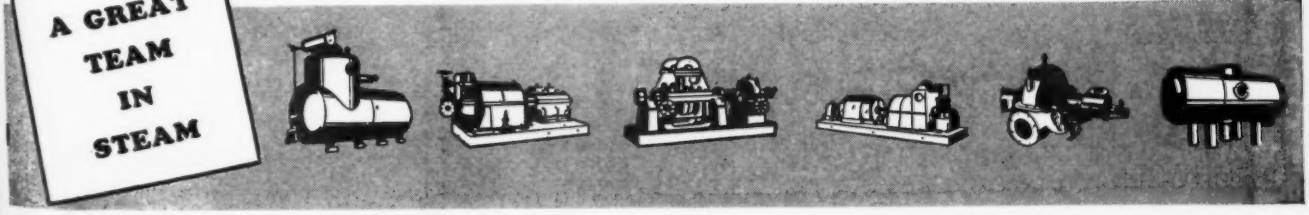
2500 KW Worthington unit installed in 1939. Turbine, straight, condensing type, operates on 400 lbs. steam pressure, 750 degrees total temperature and exhausts into a vacuum of 28"

Many similar reports from power users throughout the country testify to the trouble-free, cost-saving performance of Worthington steam turbine equipment. In your own turbine problems, Worthington specialists are always available for expert technical advice. And for further proof that *there's more worth in Worthington*, write for fact-full literature. *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

T7-1

A GREAT TEAM IN STEAM



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Inexpensive BABBITT Sprocket Rims fit all types and makes of valves, with either rising or non-rising stems. Installed quickly by clamping directly onto hand wheel of valve. Eliminates makeshift apparatus and specially-made chain wheels.

● Ten standard sizes take care of all valve wheels from 2 to 30 inches in diameter.

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Manufacturers of Adjustable Valve Operating Mechanisms
New Bedford, Mass., U. S. A.

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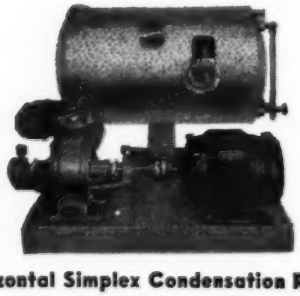
Capacities to 150 G. P. M.
(Both Horizontal and Vertical)



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Apcos are ideal for the above service or any small capacity, high head duty. The one moving part, the impeller, is free running without metal-to-metal contact. Designed for high temperature water and liquids. Capacity remains practically constant against drastic head pressure variations.

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AURORA PUMP COMPANY
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MAINTENANCE MATERIALS

23 **PROTECTIVE COATING**—United Chromium, Inc, 51 E 42nd St, New York 17, N. Y. 4-page booklet No. MC-1 presents Ucilon, a synthetic resinous coating material, for severe corrosive conditions. Properties and applications of Ucilon are given.

24 **FIRE-FIGHTING CHEMICAL**—American-LaFrance-Foamite Corp, Elmira, N. Y. 4-page folder describes a new chemical for making wetter water for more efficient fighting of fires. Pentrate makes water spread and penetrate.

25 **PROTECTIVE COATINGS**—Wailes Dove-Hermiston Dept, Koppers Co, Westfield, N. J. 26-page bulletin No. 646-1 gives a complete story on Bitumastic, a protective coating for use on metal surfaces in waterworks, pipelines, industrial plants and marine structures.

26 **SYNTHETIC COATINGS**—United Chromium, Inc, 51 E 42nd St, New York 17, N. Y. 4-page booklet discusses Unichrome synthetic coatings for specific service conditions. Properties, uses and applications are included.

27 **PROTECTIVE COATINGS**—Lithgow Corp, 333 W 40th Pl, Chicago 9, Ill. 8 page catalog on Lithcote coatings and linings discusses applications, plant and field facilities, research and actual names of users.

28 **GASKETS AND GASKET MATERIALS**—Melrath Supply & Gasket Co, Tioga & Memphis St, Philadelphia, Pa. 64-page catalog contains specifications, sizes, useful engineering data and a simplified selector chart to speed the user's selection of the proper gasket for every purpose.

MATERIALS HANDLING

29 **COAL SHAKER**—Robins Conveyors Div, Hewitt-Robins Inc, 270 Passaic Ave., Passaic, N. J. 12-page bulletin No. 128-A presents the Robins Car Shakeout. It is an independent, readily portable unit requiring no attachments to or on the car.

30 **MATERIALS HANDLING METHODS**—Factory Service Co, 4615 N 21st St, Milwaukee 9, Wis. Book, entitled "The Turner System of Materials Handling," tells how to achieve complete coordination of all steps in materials handling. Book includes illustrations showing scientifically engineered handling methods.

31 **MAGNETIC PULLEY**—Eriez Mfg Co, 2766 E 12th St, Erie, Pa. 8-page bulletin No. 501-A describes how tramp iron or other ferrous metal contamination may be automatically removed from materials traveling on conveyor belts.

32 **HOISTING RIG**—National Supply Co, Box 899A, Toledo 1, Ohio. 20-page bulletin discusses the Ideal Consolidated rig Type 125. Seventeen photos show the rig and its features.

PIPING, FITTINGS VALVES AND SPECIALTIES

33 **FULL-FLOW VALVE**—Rockwood Sprinkler Co, 38 Harlow St, Worcester 5, Mass. 4-page bulletin No. V4-10M-47 gives advantages of Rockwood ball-type valves. Specifications are given.

34 **PIPING AND FITTINGS**—Duriron Co, Dayton 1, Ohio. 12-page bulletin No. 703 discusses corrosion resistance, proper installation and use of Duriron sanitary pipe and fittings, acidproof sinks, sink strainers, traps, etc. Price List H is included.

35 **VALVE CONTROL**—Shafer Valve Co, Mansfield, Ohio. 4-page folder describes design and operation of a new line of high-pressure control valves. These valve controls are available for operation of valves from 1 in. and for pressures from 25 to 6000 psi.

36 **VALVE LINE**—Hanna Engrg Works 1765 Elston Ave, Chicago 22, Ill. 8-page bulletin No. 235 gives specifications and operating data on all Hanna valves. The line consists of foot-operated

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The quality of R/M High Pressure Packing, Style No. 122, is typical of the performance built into all R/M Packings.

No. 122 consists of a specially compounded resilient, heat-resisting rubber core, wound with bias-cut, long-fibre, asbestos cloth. It gives exceptional service on valve stems and steam or air reciprocating rods where surface speed does not exceed 600 feet per minute and temperature is not over 600°F.

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R/M

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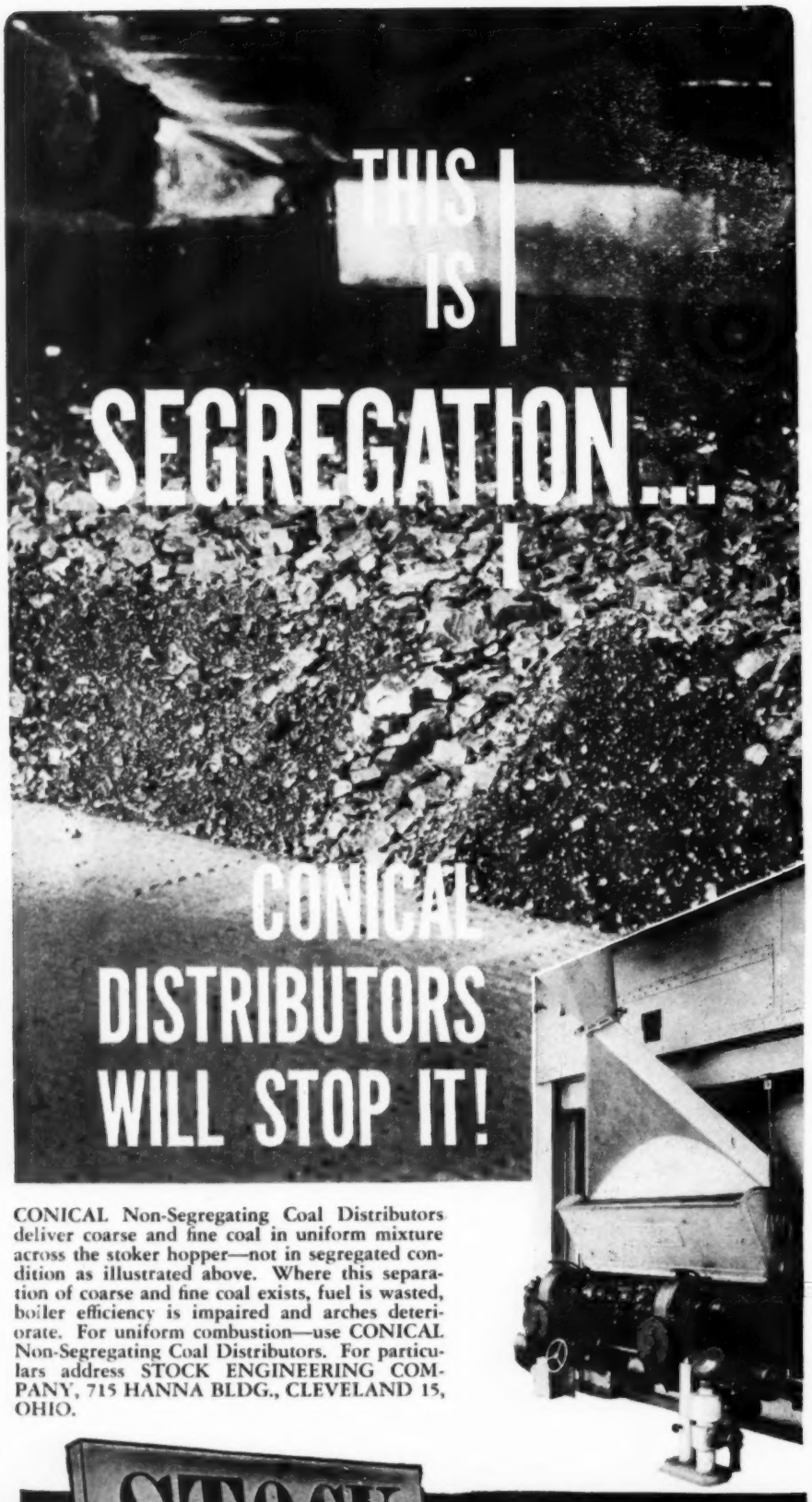

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and hand-operated valves for air and hydraulic lines, and speed control valves for air and hydraulic cylinders.

37 **VALVE INSTALLATIONS**—Birch Mfg Co, 1521 N Sedgwick St, Chicago, Ill. 28-page booklet describes Birch valve installations in large pumping stations. Photographs and diagrams are included.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **EXPANSION JOINTS** — Expansion Joint Div, Chicago Metal Hose Corp, Maywood, Ill. Bulletin No. EJ-47 discusses CMH free-flexing and controlled-flexing bellows-type expansion joints for controlling expansion, vibration and misalignment in pipelines having pressures to 300 psi and temperatures to 900 F.

OTHER EQUIPMENT

38 **JET COMPRESSORS**—Schutte & Koerting Co, 12th and Thompson St, Philadelphia 22, Pa. 12-page catalog covers various steam- and gas-jet compressors, including a section on their construction and operation.

39 **DRAFT CONTROLS**—Simplex Mfg Co, 198 N Main St, Fond du Lac, Wis. 4-page circular No. 17A describes various Simplex automatic draft controls. Drawings show different positions in which Simplex industrial controls can be placed and manner in which secondary air is delivered automatically to stack or breeching, thereby reducing, to desired point, the draft pull on the boiler.

40 **LIQUID-LEVEL INDICATORS**—Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa. 16-page bulletin No. WG-1822 contains outstanding features, operation and construction details of Yarway remote liquid-level indicators. Representative users and typical installations of these liquid-level indicators on boiler-room panels are given. Bulletin also describes Yarway control unit for remote signalling and controlling devices.

41 **DISK CLUTCH**—L W Carroll Mfg Co, 2046 Ross Ave, (Norwood) Cincinnati, Ohio. 4-page bulletin No. 10-C discusses Types CE and CEE sleeve clutches. Dimensions and list prices are included.

42 **CAST NICKEL ALLOY**—International Nickel Co, 67 Wall St, New York 5, N. Y. 36-page booklet gives detailed information on physical and mechanical properties of Ni-Resist, a cast nickel alloy.

43 **DIFFERENTIAL PRESSURE INDICATORS** — Barton Instrument Co, 3500 Union Pacific Ave, Los Angeles 23, Calif. 8-page bulletin No. 11C3 describes the Model 163 indicator for measuring flow, liquid level and pressure differentials. Single-sheet bulletin No. 181-1 discusses the Model 181 differential pressure indicator with a 6-in. dial. It differs from Model 163 in that it has a larger case and dial and in method of zero adjustment and of flush panel mounting.

44 **DIESEL ENGINES**—Superior Engine Div, National Supply Co, Springfield, Ohio. 28-page bulletin No. 4705 shows how Superior stationary diesels are designed and built. Bulletin has 46 photos, eight performance charts, standard and special equipment tables and five dimensional blueprints, including foundation sizes and amount of concrete required.

45 **PRESSURE BOOSTER** — Hydro-Power, Inc, Belmont and Sheridan Ave, Springfield, Ohio. 4-page bulletin discusses the Hydro-Power hydraulic booster, a pressure intensifier that is said to double or triple pump pressure in oil-hydraulic circuits.

46 **WATER SOFTENER** — Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 12-page bulletin No. 28B6611 presents a general description of a hot process water conditioning system. Included is a discussion of the equipment and an explanation of what it is designed to do, together with the mechanism of its operation.

Complete Cost Accounting Must Include Steam

Brown Electric Recording and Integrating Flow Meter

If steam were a raw material, every plant would make precise accounting of its consumption.

Steam is costly. It is often wasted. Departments draw far more steam than needed for efficient operations because it is "free."

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For Temperatures . . . . . Pressures . . . . . Flows . . . . . Liquid Levels

Will the system operate with stability—will it carry the load?

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TRANSIENT STABILITY discusses such factors affecting performance as: occurence, type and location of short circuits; the response of the system to sudden changes in voltage and current; speed of circuit breakers and relays; and the response of the excitation systems and governors of the synchronous machines. Mr. Crary also describes the system and machine torque-angle characteristics in detail.

Contents include:

- Fundamental Concepts for Transient Analysis
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47 CHEMICAL INDUSTRY—Dow Chemical Co, Midland, Mich. 24-page booklet tells the story of the chemical industry as concerned with Dow and also gives the 50-year history of the Dow Chemical Co.

48 ALUMINUM BRAZING—Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 12-page reprint, entitled "Torch Brazing Aluminum," by Harry A Huff, covers such topics as advantages of aluminum brazing, types of aluminum, strength and corrosion resistance, filler metals and fluxes, cleaning procedure and production torch brazing.

49 WELDING MATERIALS—International Nickel Co, 67 Wall St, New York 5, N. Y. 16-page booklet No. 186C gives materials required for the metal-arc, oxy-acetylene and submerged melt welding of nickel and the high nickel alloys. Also, there is information on type of rods to use, recommended amperages, etc.

50 CURVIMETER—Herman H Sticht Co, 27 Park Pl, New York 7, N. Y. Bulletin No. 600 discusses the new Minerva curvimeter imported from Switzerland. Distance is measured by running the instrument along the lines of a blueprint or plan.

51 INDUSTRIAL ENGINEERS—Design Service Co, 31 Fulton St, Newark 1, N J. 24-page booklet describes the services of this industrial engineering company. It has a short story on each of its offices.

Calvin V Davis, former principal planning engineer for TVA, has been assigned to go to Argentina as advisor to the Peron Government in its 5-year program of hydroelectric development. He will be in charge of designing two Argentina dams to cost more than $30,000,000 each. Davis recently resigned as southern manager at Knoxville for the Frederick R Harris Engrg Corp. He was succeeded by Admiral H E Kimmel.

Goodyear Tire & Rubber Co, Jackson, Mich., plans further extension of a general modernization program to include a $500,000 steam-generating and water-treating plant that will replace or supplement obsolete equipment. Work is already under way on the foundation of a new $100,000 building that will house two virtually new boilers, which can increase the plant's steam capacity 70%. The boilers were purchased from the War Assets Administration. Each is capable of producing 100 lb of steam per hr. The boilers were formerly at Chickasaw Ordnance plant in Millington, Tenn., which produced smokeless powder and TNT during the war. They operate automatically from a centralized control panel.

One major improvement being embodied in the modernization plan is a $25,000 fly-ash eliminator that works on the same principle as a cream separator in discharging ash into a collecting bin and permitting only gases to emit from the stacks. The new system will largely eliminate dirt normally transmitted into the air. An improved ash-handling arrangement is included in the program, along with replacements and betterments in the water-softening system.

Sunnyvale Works of Westinghouse Electric Corp, Sunnyvale, Calif., will soon begin the manufacture of ten 5000-kw unit power plants, a new engineering development that greatly simplifies installation of low-cost electric power plants.

LIGHTWEIGHT HIGH EFFICIENCY 2000° F. INSULATION

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originally developed for aircraft jet insulation now offers to all industries the following exceptional properties:

- **WITHSTANDS 2000° F. INDEFINITELY:** up to 500° F. higher for short periods—fuses at approx. 3100° F.
- **CHEMICAL RESISTANCE:** —not affected by most commercial acids—does not combine with usual components of high temperature alloys even on long contact at 2000° F.
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- **FIBER DIAMETER:** 0.00023 inches, average.
- **RESISTANCE TO VIBRATION:** Not seriously affected by extreme high frequency, high amplitude vibration of aircraft jet motor tail pipes.
- **THERMAL CONDUCTIVITY:** (graph on request)—at low temperatures — approx. 1/3 thermal conductivity of standard insulating materials. At 2000° F.—by far the lowest of all materials available.
- **AVAILABLE FORMS:** *Batt* in rolls approx. 14' long by 3½" wide by 3/16" thick *Cloth* in rolls of random lengths approx. 32" wide by 0.015" thick. Tapes, sleevings, and cordage of various widths and lengths. Loose fibers in bulk. Also, insulating blankets fully prefabricated by us to specification either permanent or removable.

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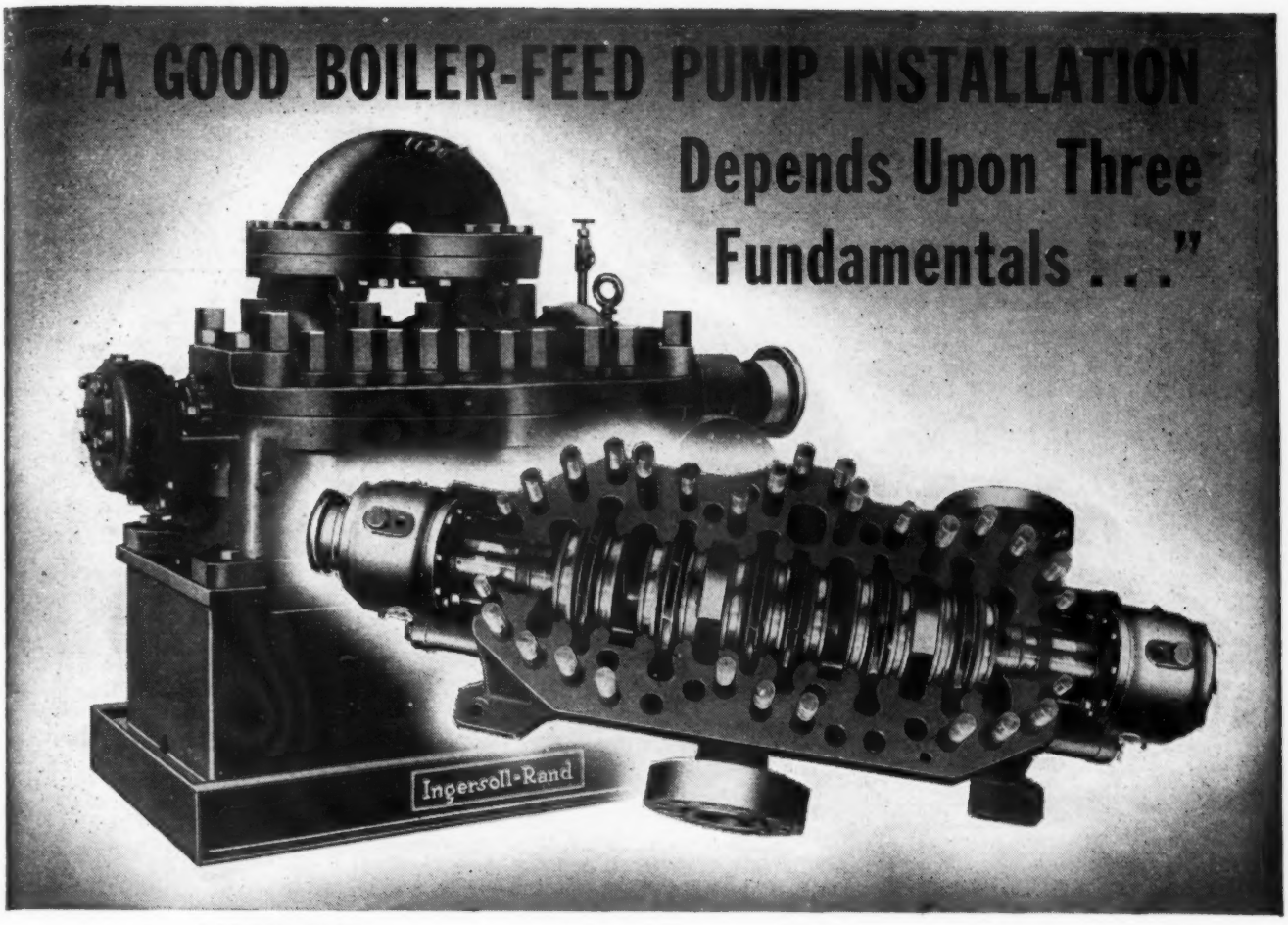
"A GOOD BOILER-FEED PUMP INSTALLATION Depends Upon Three Fundamentals . . ."



The "RT" —a medium pressure boiler-feed pump

"A good boiler-feed pump installation depends upon three fundamentals; namely, design, manufacture, and operation. If any one of these is slighted, disastrous consequences soon follow."* After careful analysis of all pertinent facts Ingersoll-Rand developed the "RT" pump, a unit that has proven itself in service to successfully incorporate the first two of these important fundamentals and facilitates the operator's arriving at the third.

Design — A wealth of experience and knowledge goes into the design of each element, such as: one-piece, closed-type impellers, a close press fit on the shaft—discharge volute passages of the various stages, placed in relative position with reference to one another so that any side reactions on impellers cancel one another and have no effect.

Manufacture—Ingersoll-Rand manufacturing methods stand at the head of the pump field because: careful selection of materials are proven and tested by an experienced metallurgical department—competent and experienced personnel assemble and inspect each element—rigorous testing is carried out in the most modern and fully equipped testing laboratory of its type. All this and more leads to the final objective, perfection in operation.

Operation — A few other important features that make for perfection of operation include:

- Extra deep, water-cooled stuffing boxes that are provided with removable throat bushings. Both stuffing boxes are under suction pressure.
- Pump bearings sealed by labyrinth type flinger rings to keep water and dust from entering the bearing housing.
- An accurately machined, ground and polished high-strength alloy steel shaft of ample proportions to insure low stresses. These are just a few of the refinements that contribute to the success of the "RT" pump in the medium pressure boiler-feed field.

**From an article by A. H. Richards, "Combustion".*

COMPRESSORS AIR TOOLS
ROCK DRILLS • TURBO BLOWERS
CENTRIFUGAL PUMPS • CONDENSERS
OIL & GAS ENGINES

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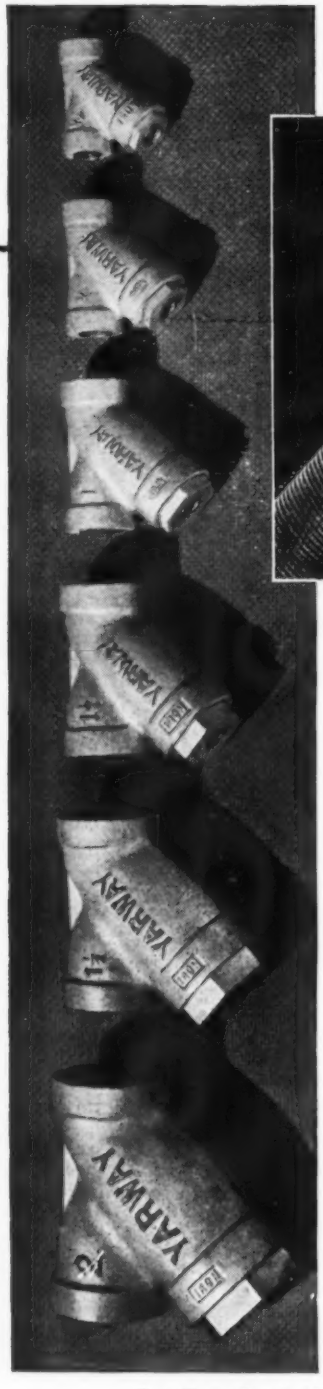

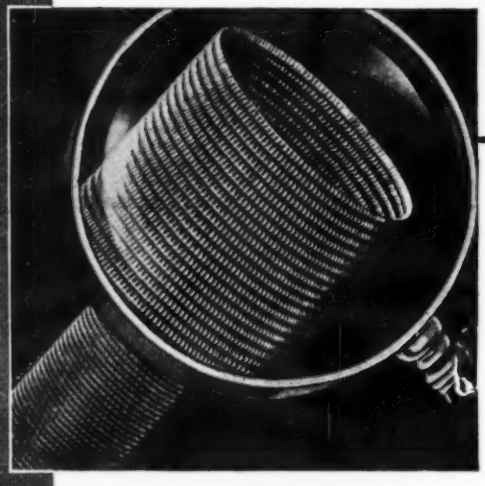

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"The Screen's the Thing"

- *A High Grade Monel Woven Wire Basket* with mesh fine enough to catch the dirt—yet ample free area for passage of clean condensate, oil and other fluids.
- *Body Cadmium plated for protection against corrosion and for better appearance.*
- *Readily Removed Steel Blow-Off Bushing.*
- *Bushing Automatically Aligns Screen.*
- *Thousands in Use—Sold by Nearly 150 Mill Supply Houses.*
- *6 Sizes ½" to 2" for Pressures up to 600 lbs.*

See Your Supply House or write for Bulletin S-201

YARNALL-WARING COMPANY

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YARWAY STRAINERS

BANGALORE, MYSORE STATE, INDIA: First generating unit at the huge Jog Falls power station in the coastal mountains of Mysore State has gone into operation, transmitting 12,000 kw to receiving station at Bhadravati—site of Mysore Iron & Steel Works. Another 48,000 kw is expected to be available some time this fall. Completion of the 120,000-kw project is scheduled for late in 1949.

NEW DELHI, INDIA: An immediate start on construction of Hirakud Dam across Mahanadi River in Orissa Province has been recommended to the government of India by a panel of experts recently appointed to study the project. The Hirakud Dam is envisioned as the first of three steps in developing the Mahandi Basin into one of the outstanding multipurpose projects in the world. The Hirakud section would have an installed capacity of 350,000 kw. Further down the river at Tikarpara Gorge it is reported possible to develop 2½ million kw, and near the coast at Naraj another 100,000-kw installation is feasible.

The main dam would be constructed across the Mahanadi about nine miles above the town of Sambalpur. The central barrier would be three miles long with 17 miles of low dikes on its wings. Maximum height would be 150 ft. above deepest river bed. It would submerge 135,000 acres, and have a gross storage capacity of 5.3 million acre ft of which 1.2 million acre ft would be dead storage.

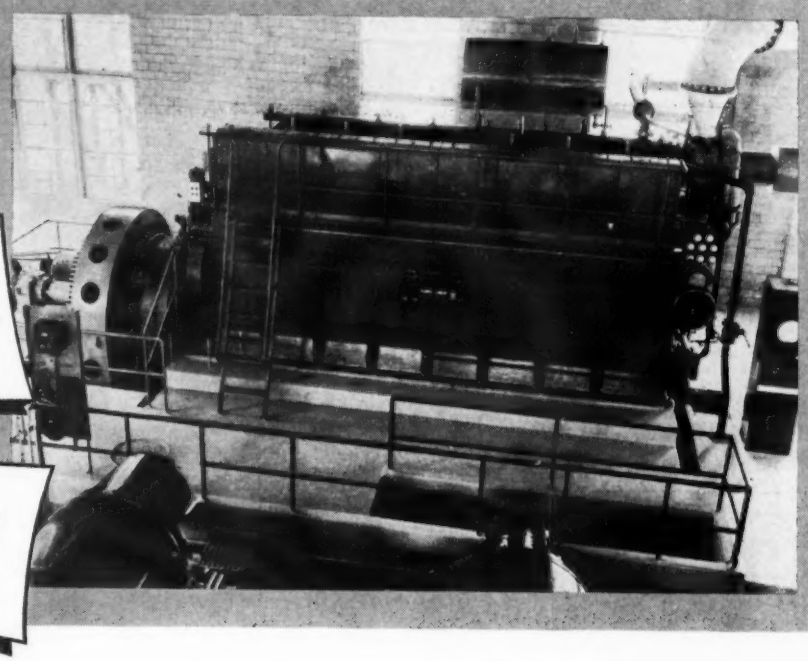
Power will be generated in two places at Hirakud. Six units of 25,000 kw each will be installed in a station at the main dam, and eight units of 25,000 kw each at a second station to be constructed below a balancing reservoir, which will be situated at the end of the 12-mile power canal. Operating head at both stations will be about 85 ft. Size and design of the balancing reservoir is not yet decided, but it will be of the earth-and-rock rolled-fill type.

As worked out by the panel of experts, cost of the Hirakud project will be about $150,000,000, of which $69,000,000 is for the hydroelectric power installations.

OSLO, NORWAY: A 14-man atomic committee to coordinate Norwegian atomic research was appointed recently by Norwegian Technical Research Council. The group, headed by Prof Svein Rosseland, will include representatives from two Norwegian universities and the Norwegian Institute of Technology, and from private industry. Primary task of the all-civilian committee will be to plan a research program and apportion projects in atomic research field. According to Oslo reports, two 3,000,000-v high-tension generators are already under construction. One of these

OVER 36% Thermal Efficiency!*

In the FIRST Supercharged Dual Fuel Diesel to Demonstrate All Its Guarantees



* Developed by this Worthington Supercharged Dual Fuel Diesel Engine, Type SEHGO-8, on acceptance test at the municipal plant, Lamar, Colorado.

* TEST DETAILS: 7050 net Btu per brake horsepower-hour at full load . . . total gas and pilot oil fuels included . . . elevation 3600 ft.

First in the U. S. to produce a 4-cycle Dual Fuel Diesel . . . first in the world to supercharge this type of engine . . . Worthington offers the Lamar data as proof of *thinking ahead* in Diesel engineering. But such records are only part of the Worthington economy story. Today, with a scarcity of all fuels in prospect, you can save by

USING THE CHEAPEST FUEL AVAILABLE

Worthington Diesels, naturally aspirated or turbo-charged, are built in three fuel-burning types — Oil, Gas or Dual Fuel. With Worthington Dual Fuel Diesels you can burn oil and gas in any ratio, or switch to either completely — and instantly — permitting lowest fuel costs under changing conditons.

CHOOSE FROM THE WORLD'S LARGEST LINE

Besides the widest range of Diesel and gas engine types and sizes, Worthington brings a wealth of experience in design, construction, and application to provide you with maximum power at lowest cost. For further details that prove *there's more worth in Worthington*, contact *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

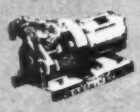
WORTHINGTON

E7—4

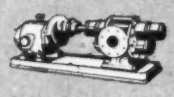
YOUR PARTNER IN POWER PROGRESS

Diesel engines, 150 to 2,640 hp . . . gas engines, 175 to 2,470 hp . . . dual fuel engines, 225 to 2,470 hp.

WORTHINGTON-BUILT AUXILIARIES



Air King Compressors



Oil Transfer Pumps

Cooling Water Circulating Pumps

Evaporative Type Engine Water Cooler

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BY HAND — IN ONE MINUTE
With the du Mont *Minute Man*
Keyway Broach Kit

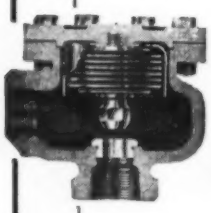
Now, you can cut keyways any standard width, any depth, in pulley hubs, collars, couplings, gears, cutters or what have you.

The new *Minute Man* Catalog, Price List and Keyway Reference Manual "P" gives you the whole story. Write for free copy.

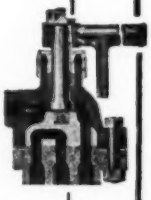
This Kit and a du Mont Arbor Press covers everything you need — precision broaches, slotted bushings, shims, keyway stock. Cut a few keyways and you've paid for it.

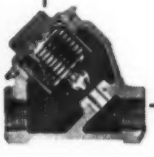
The du MONT
CORPORATION
GREENFIELD, MASSACHUSETTS

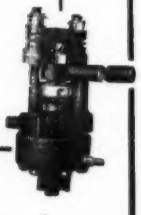
WHY MAINTENANCE MEN REPORT

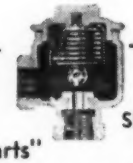


Standardizing on
NICHOLSON
VALVES & TRAPS
Pays Off









The universal order to "cut inventory of spare parts" spells standardization. Here are fundamental reasons why an increasing percentage of plants are standardizing on Nicholson steam traps and cylinder control valves.

Let us furnish you specific engineering details of Nicholson units as applied to your needs.

SIMPLICITY—Maximum freedom from trouble and ease of repair.

RUGGEDNESS — Withstand unavoidable abuse.

COMPLETE LINE—Solves supply problems.

CONVENIENT SERVICE—on specification and maintenance problems.

Send for catalogs 444 and 546 or . . .

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Manufacturers of Steam Specialties for Over Three-Quarters of a Century

will be installed at University of Oslo and the other at Norwegian Institute of Technology at Trondheim. Expansion of nuclear physics study at Oslo and Trondheim is indicated. It is further reported that Prof Lise Meitner, of the Nobel Institute, Stockholm, and Prof Eduardo Amaldi, of University of Rome, will accept chairs as guest lecturers in nuclear physics at Trondheim Institute.

MELBOURNE, AUSTRALIA: Electricity production in the Australian state of Victoria has increased at a faster rate since 1937 than in the U. S., Canada and England. This is implied in a graph published with latest annual report of the State Electricity Commission, producer of 98% of all electric power in the state.

Last year, SEC thermal and hydro plants generated 110% more electricity than in 1937, compared with about 105% more in the U. S., 70% in Great Britain and 60% in Canada. Progressive additions made to installed generating plant during and since the war, have enabled the system to meet fast-rising demands, although it no longer provides normal plant reserve above peak loads of the winters. (See POWER, March, p 103)

Completion of the Commission's 1937 development program will increase installed capacity from 549,000 to 794,500 hp. A new 30,000-kw generator at the Commission's Newport Station (thermal) will be in service by the end of the year, another two of the same capacity in 1948 and 1949. Newport is one of the five peak-load stations in the interconnected system that is capable of doubling capacity of the Yallourn Baseload Station. In addition, there are fast-expanding Kiewa and Sugarloaf-Rubicon Hydro Stations.

Two engineers of the Commission went to the U. S. to study modern developments in design and operation of large-scale transmission and tranformation of electricity at extra high voltages. These investigations will have an important bearing on transmission of electricity from Kiewa Hydro Station to Melbourne.

One of SEC's subsidiary enterprises is the winning and briquetting of brown coal: it has probably become the world's biggest operator in this line. Annual production of brown coal reaches 5,500,000 tons and briquette output tops 500,000 tons. About one fourth is retained as fuel for SEC thermal stations while the remainder is sold to industry and households.

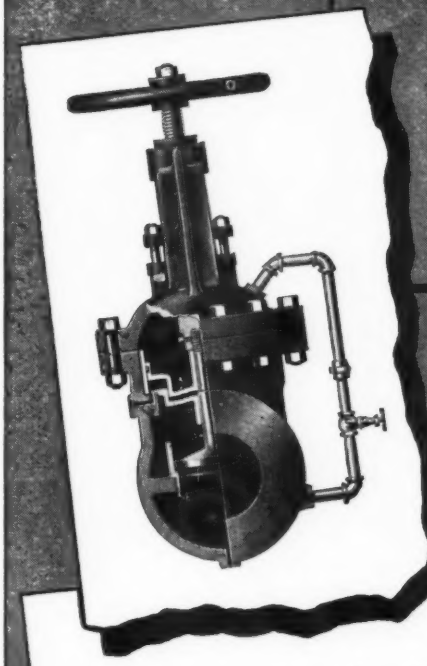
Hydroelectric power production in Alberta has been augmented substantially by bringing into operation the $1,500,000 Calgary Power Co Ltd plant on the Kananaskis River, 65 miles west of Calgary. The new 13,500-hp unit boosts the company's productive capacity to 105,000 hp. It has been under construction for two years. Other company plants in the network that now serves wide areas of Alberta are the 38,000-hp plant at the Ghost River Dam, two at Cascade, 23,000 hp and 19,000 hp, and a 12,000-hp plant at Lower Kananaskis. The new plant, which operates automatically under remote control, is the first of its type in western Canada. Pushbuttons at the Seebe plant several miles away can control its operations.

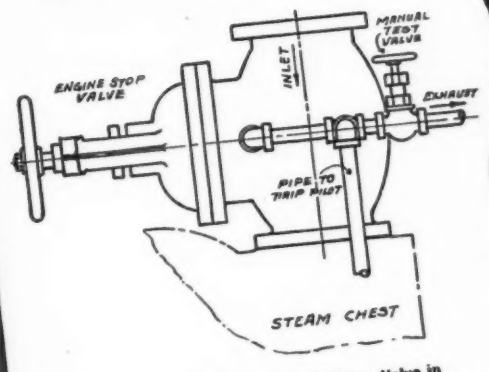
HOW TO AUTOMATICALLY PREVENT

TURBINE OR ENGINE OVERSPEEDING

install

GOLDEN-ANDERSON THROTTLE and AUTOMATIC ENGINE STOP VALVES

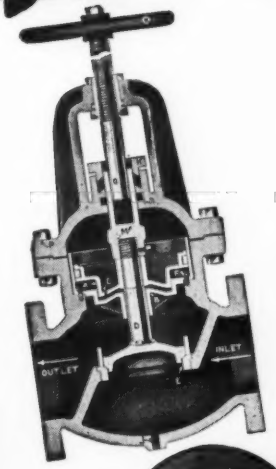




Golden-Anderson Throttle-Engine Stop Valve in horizontal position with downward steam flow.

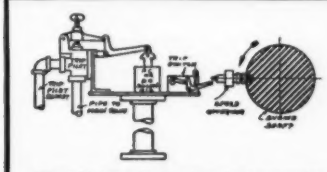
On overspeeding of engine or turbine the shaft governor may directly operate trip pilot control valve or limit switch, if solenoid trip pilot control is used, to open trip pilot control valve and permit engine stop valve to instantly close and stop engine or turbine.

By running down handwheel stem the valve may be closed any time, and by-pass valve should be closed when the valve is to be maintained in closed position over a period of time.

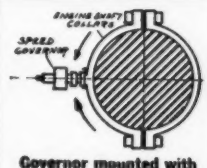


Free Engineering Aid...

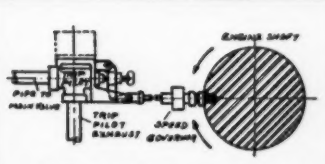
Let GOLDEN-ANDERSON engineers help you on any new or replacement valve problem.



Electric trip pilot and switch assembly with governor attached to engine shaft.



Governor mounted with split collars attached to engine shaft.



Mechanical trip pilot assembly with governor attached to engine shaft.

GA

GOLDEN-ANDERSON

VALVE Specialty Company

KEENAN BUILDING · PITTSBURGH 22, PA.

ADD PRESSURE SEAL

to quicker fit...

THIS MAY BE NEWS to you ... You can get all the advantages of Laminum *plus* the sealing of oil and pressure in bearings ... in *babbitted* Laminum shims. The babbitt lugs are securely locked into the Laminum. Details on request.

Laminum shims are cut to your specifications. For maintenance work, however, shim materials are sold through industrial distributors.

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THE SOLID SHIM THAT peels FOR ADJUSTMENT

APPOINTMENTS

Bailey Meter Co announces that the last members of the 1946–1947 cadet engineering class have been assigned to the company's branch offices: J H Wilson reported to Cincinnati and R W May to New York.

Frank M Higgins has been made manager of **Reeves Pulley Co** branch office in Atlanta, Ga.

Cutler-Hammer, Inc, has new and expanded quarters in Cleveland at 2010 E 46th St. R J Eckstein is Cleveland district sales manager. Company has a new branch sales office at 107 N Franklin St, Saginaw, Mich. R L Hibbard will manage the new office as a branch of Detroit district sales office.

A Harold Smith has been appointed New York district sales manager and P H Potts New York branch manager of **Quaker Rubber Corp,** with headquarters in New York City.

Chicago Metal Hose Corp has named Edwin A Wert director of sales for new expansion joint div, with offices in Maywood, Ill.

M J Rahiya has been made engineering sales and service representative in Louisville, Ky., for **Liquid Conditioning Corp.** The company has moved its offices to larger quarters at 1111 Heyburn Bldg, Louisville 2, Ky.

Rockbestos Products Corp is opening its own offices and warehouse at 3100 E 10th St, Oakland, Calif., with Philip O Weston, district manager of Pacific Coast territory, in charge. Company expects to open a sales office in Los Angeles.

W V Merrihue has been appointed manager of community and employe relations for **General Electric** apparatus dept.

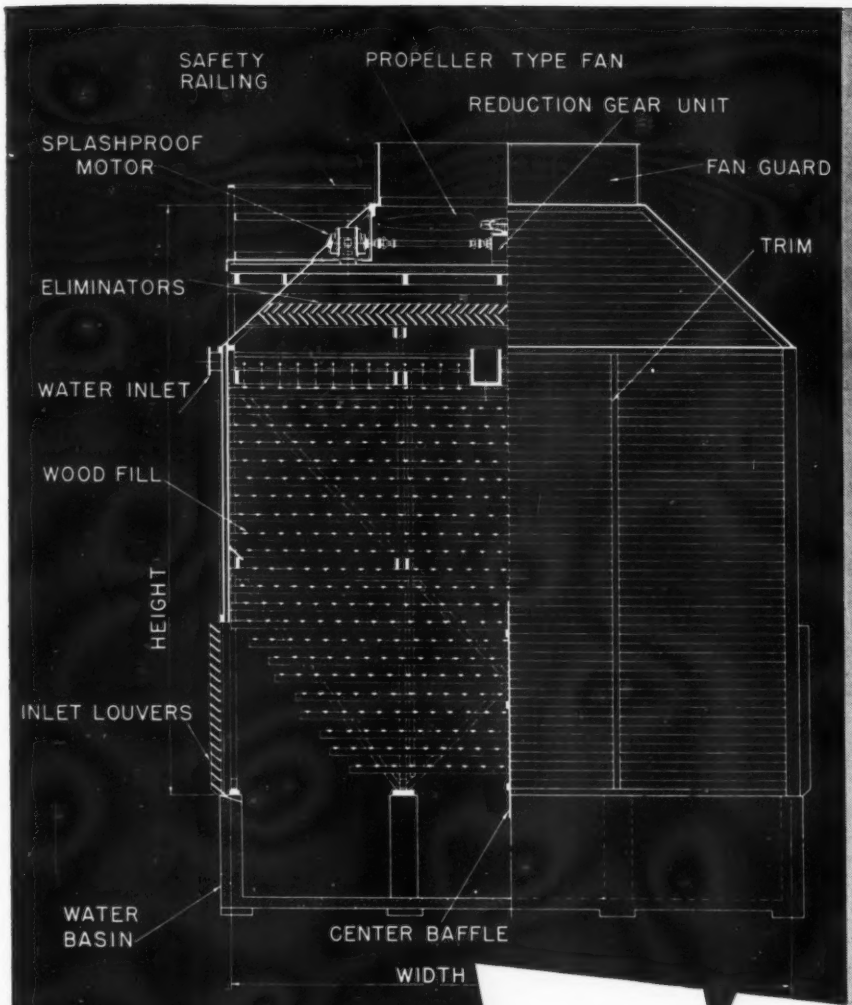
Sterling Engine Co elected James B Porteus president and member of board of directors.

Robert D Stuart has been appointed sales promotion manager of general products div, **United States Rubber Co.** A G Westlund has been made manager of sales production coordination dept of tire div.

Building materials div of **Armstrong Cork Co** reopened its office in Omaha, Neb. The new office is at 305 S 17th St. T D Lent has been moved to Omaha to act as representative from that point. The office will function as a branch of the division's district office in Kansas City.

Pittsburgh Consolidation Coal Co announced appointment of Gerard C Gambs as manager of service dept of research and development div. W D McElroy was named manager of development dept and D Leigh Fowler manager of patent dept of this div.

Detroit Diesel Engine Div, General Motors Corp, assigned Lauren H Wells as sales engineer for northern West Coast zone. He will direct industrial, marine and



Maximum Wind Velocity Recorded Up To 1943

• • •

United States Department of Commerce Weather Bureau Stations

Albany, N. Y.	59 mph, Jan. 25, 1879
Amarillo, Tex.	70 mph, Apr. 30, 1942
Baltimore, Md.	54 mph, July 20, 1902
Birmingham, Ala.	46 mph, Aug. 13, 1907
Chicago, Ill.	65 mph, Feb. 12, 1894
Cincinnati, Ohio	43 mph, Mar. 30, 1922
Cleveland, Ohio	61 mph, May 19, 1940
Des Moines, Iowa	50 mph, April 1, 1892
Detroit, Mich.	67 mph, Nov. 29, 1919
Duluth, Minn.	68 mph, Mar. 16, 1941
Kansas City, Mo.	63 mph, Aug. 25, 1941
Knoxville, Tenn.	59 mph, Mar. 25, 1873
Lynchburg, Va.	49 mph, Oct. 18, 1916
Memphis, Tenn.	58 mph, Mar. 9, 1901
New Orleans, La.	66 mph, Sept. 29, 1915
New York, N. Y.	73 mph, Feb. 22, 1912
Oklahoma City, Okla.	57 mph, June 29, 1918
Philadelphia, Pa.	68 mph, May 24, 1933
Pittsburgh, Pa.	56 mph, Jan. 19, 1926
Portland, Oreg.	43 mph, Mar. 25, 1897
St. Louis, Mo.	62 mph, May 27, 1896
Salt Lake City, Utah	60 mph, Nov. 11, 1937
Sandusky, Ohio	54 mph, July 11, 1879
Tacoma, Wash.	52 mph, Dec. 21, 1940
Toledo, Ohio	65 mph, Mar. 21, 1913

WIND-SAFE COOLING TOWERS FOR ALMOST EVERYWHERE

C. H. Wheeler Water Cooling Towers are guaranteed to withstand wind velocities of 100 miles per hour (75 m. p. h. is hurricane velocity). Official records of the United States Weather Bureau reveal that, aside from tornadoes and tropical hurricanes, only two of their 218 stations have ever recorded winds exceeding 100 m. p. h. which lasted 5 minutes or more, and these were at isolated locations; four others have recorded 100 m. p. h. winds lasting only a very short period of time. Above list shows the maximum wind velocity ever recorded by weather bureau stations up to 1943 in a few industrial sections. Guaranteed wind resistant construction, plus guaranteed water cooling performance, efficient operation with minimum water losses and over 50 years' experience are reasons why you should use C. H. Wheeler Cooling Towers. Send for our Catalog No. 145 today.

C. H. WHEELER MFG. CO.
1800 Sedgley Avenue, Philadelphia 32, Pa.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

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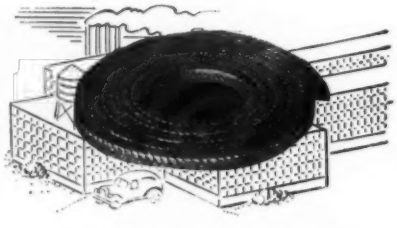
STEAM CONDENSERS • AIR EJECTORS
COOLING TOWERS • HEAT EXCHANGERS
OF PHILADELPHIA

WOULD ONE OF THESE *Packings* END ONE OF YOUR PACKING PROBLEMS?

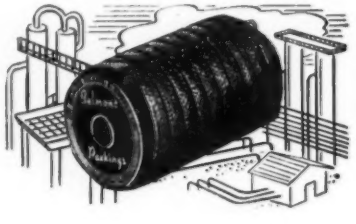
As examples of the extra service you get from Belmont Packings, here are three packings built with special features to give you better sealing and longer life. And for *any* steam, water, oil, gas, air, acid, alkali or ammonia service . . . tell your distributor: "Belmont".

Extra sensitive to gland pressure. Belmont 2 Diagonal Wedge Expansion Packing has sliding rubber and duck diagonal wedges incased on three sides with rubber and duck channel. For reciprocating rods and plungers (especially when worn) working against hot and cold water, steam up to 340°F., ammonia.

For rotating shafts. Every strand of asbestos yarn in Belmont 754-P Centrifugal and Rotary Pump Packing is thoroughly lubricated and graphited, resulting in a packing that will keep pliable for long, economical service.



For gasoline and other petroleum distillates. Belmont 6100 is made of a high-grade asbestos yarn, firmly braided, each strand thoroughly impregnated with a special compound to retain softness and essential sealing qualities when applied against volatile distillates.



There is a Belmont Packing for Every Service

Belmont distributors are located in every large industrial center, ready to give you prompt delivery from local stocks.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

IN THE BLUE-AND-ORANGE BOX

6 New Folders
Write us for new folders on Belmont Centrifugal and Rotary Pump Packings, Flax Packings, Oil Hollow Center Packings, Rod and Gasoline Packings, Sheet Packings.

THE BELMONT PACKING AND RUBBER CO.

Butler and Sepviva Streets

Philadelphia 37, Pa.

petroleum distributors sales in Wash., Ore. and northern part of Idaho. Victor Hansen will take over southern West Coast zone in similar capacity, with distributors in Calif., Ariz. and eastern Nev. under his jurisdiction. Hansen will make his headquarters at Oakland, Calif. Wells and Hansen filled vacancies left by Murrison C Wright and James R Williams, who took over northern Calif. distributorship franchise for sale of General Motors Series 71 marine and industrial diesel engines.

Boyd V Giesey has been named to head all sales of **Progressive Welder Co** resistance welding equipment in state of Mich., north of Detroit. Giesey is opening new offices at 320 S Larch St, Lansing, Mich. He will be assisted in the new operation by Robert O Wight. Progressive Welder Co has acquired Warren Alloy & Machine Co of Warren and Detroit, Mich. Acquisition of the nonferrous foundry will give Progressive a direct source of heat-treated alloy castings required in manufacture of resistance welding equipment. Both plants will be operated as a separate div under name of Warren alloy and machine div.

Harold S Falk, president of Falk Corp. was elected to board of directors of **Allis-Chalmers Mfg Co.** William C Krecklow has been promoted to production control manager of company's West Allis general machinery works. He succeeds Harold A Wallace, who has resigned. Arthur A Ryan succeeds Krecklow as electrical manufacturing div superintendent.

Leeds & Northrup Co announces retirement of L R Garretson, advertising manager, because of ill health. Kenneth W Connors succeeds Garretson.

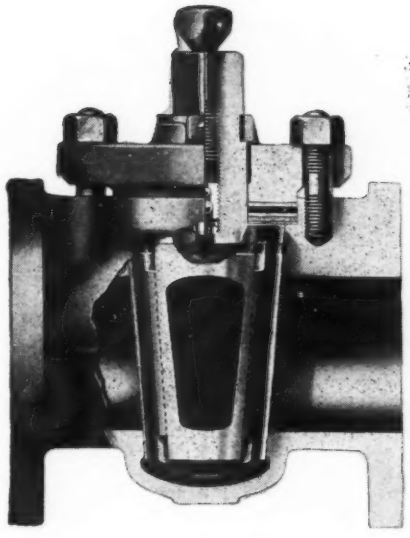
Julius A Kayser has been made assistant to president of **Laclede-Christy Clay Products Co.** Laclede-Christy bought all of the capital stock of Osceola Silica & Firebrick Co, Osceola Mills, Pa. Albert B Agnew has been made general manager of the Osceola company.

Gardner-Denver Co has sold its governor business to Wiebmer Machine Shop of Quincy, Ill. Gardner-Denver will henceforth concentrate on its expanding business in rock drills, air compressors, pumps and other allied products.

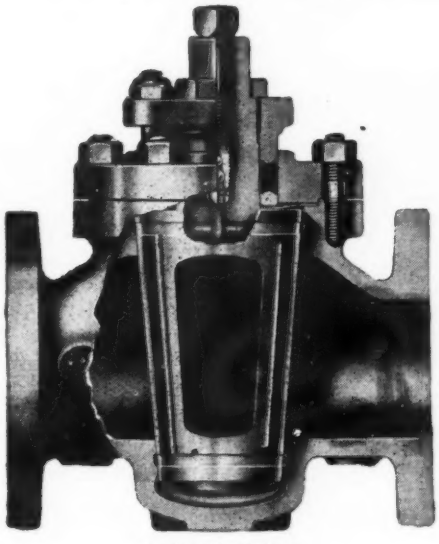
Penn Electrical Engrg Co announces resignation of E P Dietrick.

Charles Stanton has been appointed district field engineer in Philadelphia office of **Chain Belt Co.**

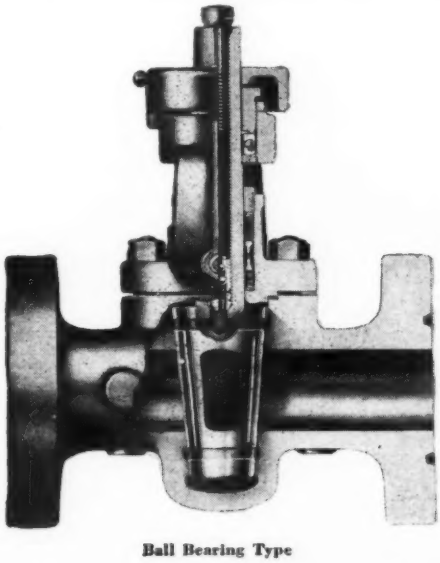
Calco chemical div, **American Cyanamid Co,** Bound Brook, N. J., announced appointment of Dr H B H Cooper as an assistant manager of development dept. Pigment dept of Calco chemical div has named E Carling, K A Coate, S F Dimlich and L C Green as regional sales managers. These appointments were made known simultaneously with establishment of four regional sales territories. (1) Carling will make his headquarters at New York office of Calco chemical div, which was recently



Single Gland Type



Regular Gland Type



Ball Bearing Type

FOR HANDLING

Acids... Solvents... Sludges...

and other troublesome liquids—

USE WALWORTH LUBRICATED PLUG VALVES

When handling acids, condensates, dyes, oils, solvents, solutions, slurries and hundreds of similar "troublesome" liquids, you get better control, more dependable service and lower operating costs with Walworth Lubricated Plug Valves.

These valves have proved their ability to give easy operation . . . fast action . . . tight shut off . . . greater protection against corrosion. Turning is smooth and easy; just a ¼ turn from full-opening to full-closing. Moreover, Walworth Lubricated Plug Valves are tightly sealed against leaks — *whether open or shut.*

Walworth Lubricated Plug Valves are available in sizes ½" to 24" for pressures from 125 to 5,000 psi, and for vacuum requirement. For further information about Walworth's Complete Line of Lubricated Plug Valves, see your Walworth distributor or write for Catalog No. 46L.

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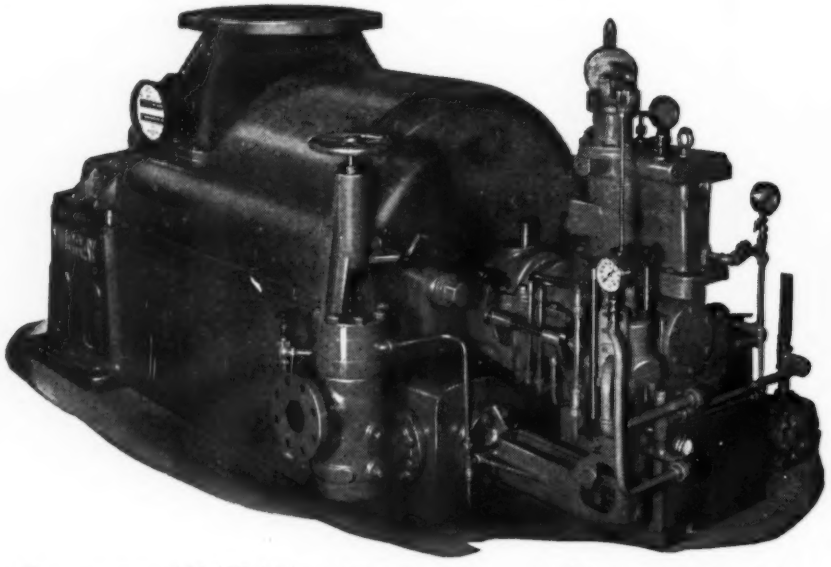

One of two MURRAY multistage steam turbines, designed to deliver 685 horsepower on steam at 110 pounds and exhausting to 26½ inches Hg vacuum, furnished to drive high speed centrifugal compressors for refrigeration in one of the most prominent Southern Hotels. A third unit has recently been shipped. Equipment includes variable speed oil relay, governor, trip and throttle valve, strainer surrounding the double seated balanced governor valve, and force feed lubrication.

MURRAY
MULTISTAGE
STEAM TURBINES

★ ★ ★ ★

The complete MURRAY line of steam turbines includes all variations of mechanical drives, and turbine generator sets up to and including 3000 KW rating.

Sales Representatives for Murray products are located in all principal cities.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of steam Power Equipment for Three Quarters of a Century

relocated at 48 W 38th St. His territory will comprise metropolitan New York, New England, Philadelphia and Baltimore areas. (2) Dimlich's headquarters are at 4500 Euclid Ave, Cleveland, Ohio. The territory for which he is responsible includes Cleveland, Detroit, Pittsburgh and Buffalo areas. (3) Coate's headquarters are at 228 N La Salle St, Chicago. His territory will include Chicago, Cincinnati, St. Louis and the South. (4) Green's headquarters are at 111 Sutter St, San Francisco. He will be responsible for sales of the pigment dept on the Pacific Coast.

Airetool Mfg Co announces appointment of Thor Thornson as general sales manager. Thornson will be in charge of sales, advertising and promotion.

Herbert O Tittel has been named production superintendent of Trenton, Mich., plant of **Monsanto Chemical Co.** Elmer P Wheeler has been made director of a newly formed section of industrial hygiene in medical dept. Ralph J Holtschlag and Robert E Howard were promoted to group leaders in St. Louis research dept of organic chemicals div.

The name of the Merritt Engrg & Sales Co has been changed to **Merritt-Monsanto Corp.** The organization became a part of Monsanto Chemical Co in 1944.

Associated Equipment Distributors moved to 360 N Michigan Ave, Chicago 1, Ill.

Wendell J Farrischon has been appointed news editor of **Caterpillar Tractor Co** news service, succeeding Jerry Reichart who has resigned. Jerry Cook has been added to the staff as news writer, supplementing work of Fred J Tuerk and J C MacMillan.

Electric Equipment Co established a New York sales office at 224 E 38th St, New York City.

John F Scott has been appointed chemical and metallurgical sales representative of New York district office of **Globe Steel Tubes Co.** Scott has been assigned to staff of R R Lally, vice-president in charge of the New York office, located in Lincoln Bldg, New York City.

R-S Products Corp promoted David W Hopkins to executive vice-president.

Gustave Treffeisen has been made sales manager of Alemite distribution div of **Stewart-Warner Corp,** succeeding Charles I Kraus. Kraus will become Alemite distributor at Minneapolis, Minn.

Walter Raleigh McDonald, chairman of Georgia Public Service Commission, has been elected president of **National Association of Railroad and Utilities Commissioners.**

Rossiter Holbrook and C J Hunter announced their association as **Holbrook & Hunter,** 89 Broad St, Boston, Mass., engineering sales representatives in New England for Thermix Corp, Prat-Daniel Corp.

Boiler Feedwater must behave...

Dearborn Engineer making a water analysis in the field.

when your engineers,

Dearborn Research, and

Dearborn Service

work together

THE most baffling water treating problems are solved through the cooperation of technically trained and research-minded water-treatment engineers together with your engineering staff.

Operating difficulties with respect to the water and steam cycle are "ironed out" when these forces meet.

Scale deposits—corrosive action—steam contamination are effectively controlled by the use of correctively formulated treatments together with proper application methods and suitable test control procedure.

Dearborn service is the inexpensive scientific approach to your feedwater problems. Consult the near-by Dearborn Engineer or write to us direct.

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"THE *LEADER* FOR 60 YEARS"

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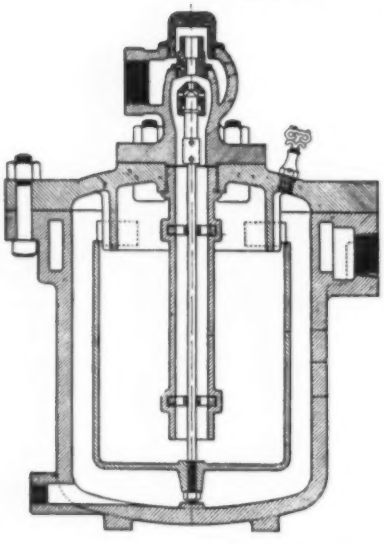
STICKLE TRAPS GIVE SUPERIOR PERFORMANCE

Simple Dependable Economical



WHY

1. The Stickle Open Float opens and closes the valve. When float is full, weight of condensate causes it to drop, or sink, pulling valve away from seat. Pressure then empties trap. Regaining buoyancy, float rises, snaps valve back into seat, and closes trap. This positive movement of Open Float, actuating valve, constitutes trap's mechanical action.

2. Condensate passes out through large tube extending down into float. Baffle ring extending down from top of chamber acts as separator of water and steam as trap discharges. Internal by-pass eliminates air and gases with discharge. When float closes valve, sufficient water remains to form water seal. Trap does not blow steam at end of discharge.

3. Open Float rides freely in water surrounding it. Float cannot stick. No point of friction for either float or rod connecting float with valve.

4. Discharge of trap causes rotating movement of float which gives continuous regrind of valve and seat, maintaining smooth surfaces and proper fit.

5. Valve and seat, only parts subject to actual wear, are made of long-lasting Chromium steel.

● Smoother operation, increased production volume, and decreased operating costs are advantages which flow from the use of Stickle Open Float Steam Traps. Stickle design and construction assure the desired performance results. There is a Stickle Trap for your conditions of operation that will provide drainage for maximum production efficiency and give dependable, trouble-free service throughout a long service life.

Stickle Series AE Traps have four times the capacity of standard traps and meet drainage needs of a wide range of industrial processing operations. Capacity range, 5,000 to 40,000 lbs. per hour. Operating pressure range, 10 to 200 lbs. See Bulletin No. 315.

Stickle Series 50 Traps with eight times capacity of standard traps are especially adapted for requirements of processing operations using high pressure steam in large volume, such as in large open tank cooking. Adjust automatically to variable rates of condensation and variable conditions of pressure. Capacity range, 18,000 to 46,000 lbs. per hour. Operating pressure range, 30 to 200 lbs. See Bulletin No. 515.

Stickle Series T Traps are for drainage of various types of equipment operating at medium and low pressures and on vacuum. Series includes radiator traps, small to large utility traps, and traps of extra large capacities. See Bulletin No. 415.

Stickle Series 100 Traps, designed for straight-in-line installation, meet the requirements of all types of smaller equipment operating at medium to high pressures. Capacity range, 250 to 5,000 lbs. per hour. Operating pressure range, 10 to 200 lbs. See Bulletin No. 115.

STICKLE STEAM SPECIALTIES COMPANY

SPECIALIZING FOR MORE THAN 40 YEARS IN REDUCING THE COST OF STEAM

2265 Valley Avenue, INDIANAPOLIS 18, INDIANA

Aerotec Corp, Heacon damper, Rockwell blast gate valves, Forney Engrg Co, Hydrotron Corp, Wedgeplug Valve Co and Wyssmont Co.

Proctor Electric Co has promoted C Roger Turner to director of research.

Union Chain & Mfg Co has appointed George H Harris manager of new Milwaukee office at 606 W Wisconsin Ave.

A M Kuehmsted has been transferred to New York branch of **Santa Fe Tank & Tower Co** at 400 Madison Ave, New York City. He will take over district management of cooling towers, air-cooled units and wood tanks.

General Power Plant Corp has announced appointment of an advertising agency, Sheldon, Quick & McElroy, Inc, of New York.

E W Deck has been retained by **Borg-Warner Corp** as a consultant on manufacturing research.

Philadelphia Electric Co has named Vincent P McDevitt general counsel in charge of legal dept, succeeding the late Bernard P Carey.

Charles S Thorn has been elected president of **Birmingham Electric Co,** succeeding William M Rogers. Although Rogers has resigned as president he will continue as chairman of board of directors.

Fred B Wilson retired Sept 1 as assistant to president of **Georgia Power Co** to devote more time to his other business interests.

Jerry W Carter has been named acting chairman of the **Florida Railroad and Public Utilities Commission** to succeed the late W B Douglass.

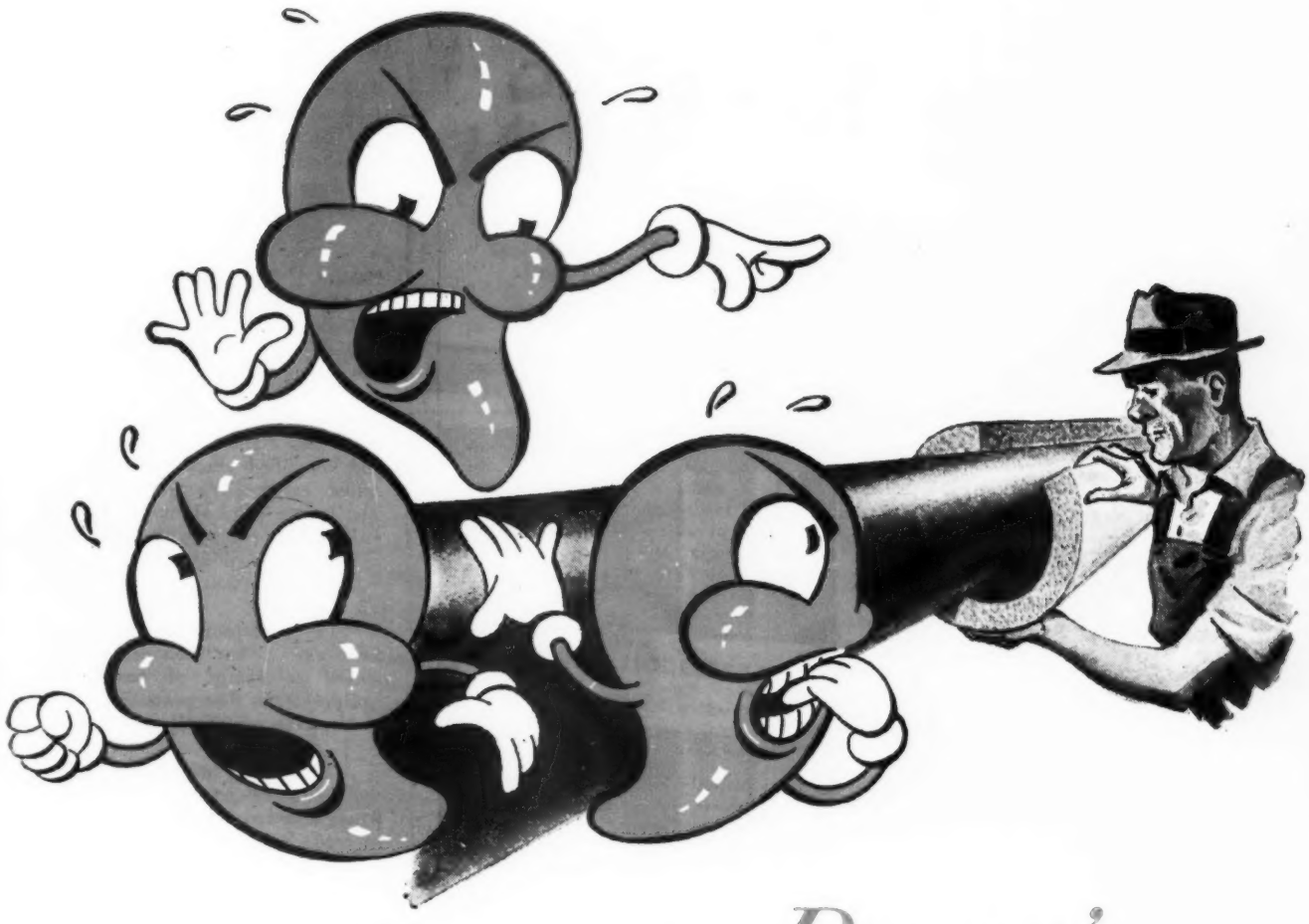
Firm of **Wearn, Vreeland, Carlson & Sweatt, Inc,** 72 Wall St, New York 5, N. Y., has been formed for specialization in surveys and reports, design and construction of power generation, transmission and distribution facilities.

Bituminous Coal Research, Inc, has appointed Joseph A Bogan business assistant.

Robert Brooks McClave, former president of McClave-Brooks Co, Scranton, Pa., has set up a sales and service organization, known as **R B McClave Engrg Co,** 149 Broad St, Philadelphia, for power-plant equipment manufactured by recognized and established firms.

David Gordon & Co, chemical, mechanical and industrial engineers, 29 Broadway, New York City, announces election of David Gordon as president.

E C Metcalf, electrical and mechanical consulting engineer, has opened an office in Columbia Bank Bldg, Wenatchee, Wash. In establishing an office in Wenatchee, Metcalf will conduct his own independent engineering business and at same time be an



bad news for BTU's

When **CAREY** Heat Insulation comes into the picture, high-priced BTU's know play days are over. From then on, it's less shirking, more working. Heat energy will be held on the job to do a job, instead of sneaking through bare surfaces or inadequate insulation barriers.

THAT CUTS COSTS! And with today's driving emphasis on savings in production rather than on production at any price, it's a mighty important consideration for everyone. That's why *no one* can afford to take insulation conditions in *any* plant for granted.

That's also why you'll want to make full use of **CAREY'S COMPLETE INSULATION SERVICE.** Seventy-four years of experience . . . well-rounded insulation engineering service . . . warehouse stocks from coast to coast . . . a complete line of insulations for industrial needs . . . that's what you get when you call in **CAREY** on an insulation job.

If you have an immediate insulation problem we'll be glad to help. In any event you'll want to . . .

WRITE FOR YOUR FREE COPY . . . of this helpful booklet. It's an excellent guide to selection of proper insulation, contains specifications and tables you want handy for ready reference. Gives a complete picture of the **CAREY** Heat Insulation line, too. A *free* copy of "Heat Insulation for Industry" is yours for the asking. In requesting yours, address Dept. P-10.

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KEWANEE
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• For 6 to 30 H. P. at 100 lbs. W. P. Like a steel bridge you can't wear it down. Every part is accessible and it's easy to handle. Truly trouble-free and economical to operate. For Oil, Gas, Coal.
For 6" Scale with pipe diameter markings—WRITE Dept. 99-K10
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For Long Service Life...
CORNING GAUGE GLASSES, SIGHT GLASSES, OIL CUP AND LUBRICATOR GLASSES More Than Meet Requirements
PYREX HIGH PRESSURE
MACBETH

For trouble-free service, always specify Corning products when you need gauge glasses, sight glasses, oil cup and lubricator glasses. Made to exacting standards and tested for pressure and temperature shock, you can be sure that the product you select will stand up.

Gauge Glasses: PYREX and CORNING brand tubular gauge glasses and Macbeth brand flat gauge glasses provide good visibility over prolonged periods, and even under severe conditions.

Sight Glasses: PYREX brand sight glasses are made especially for ovens, absorption columns, reaction kettles, furnaces, pressure vessels, stills and tanks of any kind where safe, internal visibility is necessary.

Oil Cup and Lubricator Glasses: PYREX and CORNING brand products give you visibility plus long life.

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TECHNICAL PRODUCTS DIVISION: GAUGE GLASSES • GLASS PIPE • LIGHTINGWARE SIGNALWARE • LABORATORY GLASSWARE • OPTICAL GLASS • GLASS COMPONENTS

associate of the firm, R W Beck and Associates. Metcalf specializes in operations of power plants and industrial machinery.

William H Klein has joined the consulting staff of **Gilbert Associates, Inc.** Klein will direct activities of Gilbert organization in solution of engineering and operating problems of cement and rock products industries. He will make his headquarters at the firm's general offices in Reading, Pa.

Donald V Steger, formerly director of industrial relations of John B Stetson Co, Philadelphia, was elected executive secretary of **Western Society of Engineers,** succeeding Leigh S Keith.

National Bureau of Standards consolidated two divisions, commercial standards and simplified practice, into a single div called commodity standards. Edwin W Ely, former chief of simplified practice divisions, has been appointed chief of the div and F W Reynolds, former acting chief of commercial standards, assistant chief.

Wells N Thompson, vice-president of H K Ferguson Co, has been named project director, in charge of constructing and equipping the first peace-time atomic pile at **Brookhaven National Laboratory.**

E A Buxton has been elected chairman of the committee on steel pipe research of **American Iron and Steel Institute.** He succeeds E P Corey, who has retired after 52 years in steel pipe industry. Oscar I Strickland was elected vice-chairman of the committee.

R C Matthews retired as secretary-treasurer of **Tau Beta Pi Association** after serving as a national officer of the society for 42 years. He has been named secretary-treasurer emeritus and is succeeded by Robert H Nagel, who becomes secretary-treasurer and editor of the association on a permanent, full-time basis.

At annual meeting of Toledo Control of **Controllers Institute of America,** E P Heiles, controller of Surface Combustion Corp, was elected president of that city's control.

OBITUARIES

Thomas W Rouston, 90, died at New Harbor, Me., on Aug 15. He was engineer in charge of first electric-light plant built in Boston at the Bijou Theater under direction of Thomas A Edison, which was the inception of the present Boston Edison system.

Alfred L Lindsay, 68, engineer of the Medical Center Co, Cleveland, which provides the power for University Hospitals and other buildings comprising western Reserve University, died Aug 11.

Dr W E Wickenden, 64, president emeritus of Case School of Applied Science, Cleveland, Ohio, died at Peterboro, N. H., on Sept. 1. Dr Wickenden had also served as president of American Institute of Electrical Engineers.

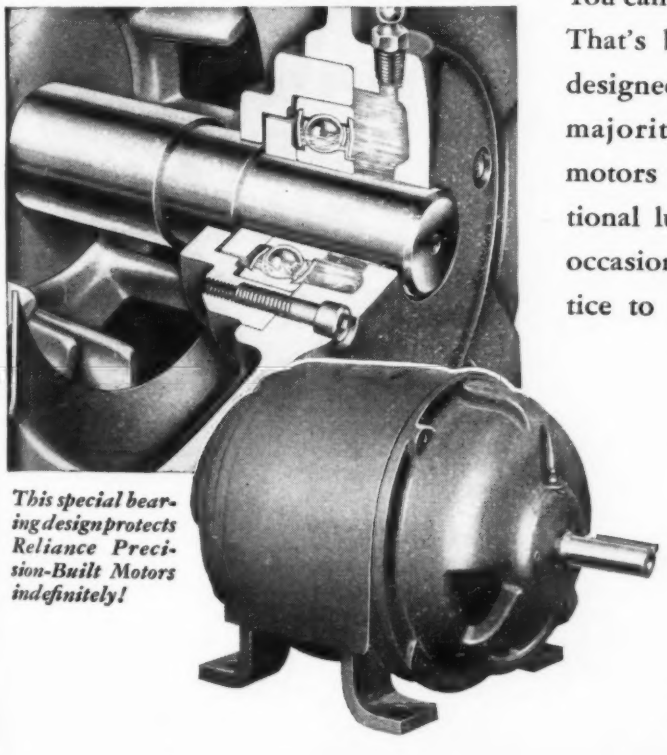
No guessing about greasing

with

RELIANCE

Precision-Built

MOTORS



This special bearing design protects Reliance Precision-Built Motors indefinitely!

You can't grease 'em wrong! *Any* way's the right way. That's because Reliance *Precision-Built* Motors are designed to eliminate lubrication worries. On the majority of applications these factory-lubricated motors perform dependably *for years* without additional lubrication. In cases where conditions make occasional attention necessary—or if it is your practice to lubricate at regular intervals—overgreasing or undergreasing make no difference. Send for Bulletin C-118 which tells how Reliance *Precision-Built* Motors end your lubrication worries!

RELIANCE ELECTRIC & ENGINEERING CO.

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RELIANCE A·C D·C MOTORS

"Motor-Drive is More Than Power"

EXTRA SERVICE

"STANDCO"
PILLOW BLOCKS

There's Extra Value in these rugged, well-designed "Standco" Pillow Blocks with their life-long, trouble-free service.

They are fully able to "take it," and have babbitted, accurately broached bearing surfaces, with faces machined to a "T". Easy to clean, easy to lubricate.

Write for Bulletin.

"Unbrako" and "Hallowell" Products are sold entirely through Industrial Distributors

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STANDARD PRESSED STEEL CO.
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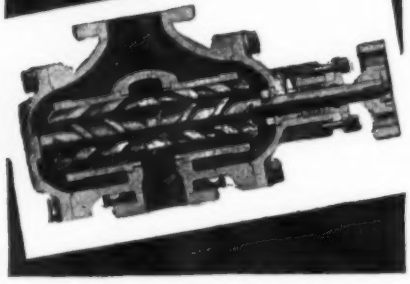
NO GEARS



The IMO PUMP requires no gears, because the fluid pumped is propelled from suction to discharge by the action of three intermeshing rotors. That's all there is to it—no gears, valves, vanes or pistons!

For simplicity, reliability and compactness select the IMO—for use in hydraulic service, governor service, lubrication service and other fluid handling services.

For further information send for catalog 1-132-P

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

Herbert J Drane, 84, Florida congressman for 16 years, former president of the Florida Senate and former member of Federal Power Commission for four years, died Aug 11 at his home in Lakeland, Fla.

Thomas F Rice, 56, manager of Boston office of Hartford Steam Boiler Inspection & Insurance Co for the past 10 years, died suddenly at the Newton-Wellesley Hospital on Aug 8.

Joseph Emery Sirrine, 74, one of the South's best-known industrial engineers and senior partner in firm of J E Sirrine & Co, Greenville, S. C., died at his home Aug 7.

Arthur G Roberts, 63, stationary engineer at Colonial Radio Corp, Buffalo, died at his home recently.

Frank G Willson, 68, head of electrical dept at Wentworth Institute, Boston trade school, and a member of its staff for 34 years, died at Newton, Mass., on July 29.

Edward H Lamy, 62, a stationary engineer for more than 35 years, died recently in his home in Buffalo after an illness of about eight months. He had been associated with several Buffalo firms, including General Ice Cream Corp and Hewitt Rubber Corp.

Lester O Stearns, 53, residential div sales manager of York-Shipley, Inc, York, Pa., died of a heart attack Aug 1 while at work.

J Carroll Kennedy, vice-president of Kennedy Valve Mfg Co, Elmira, N. Y., died June 23 at St. Joseph's Hospital in Elmira.

John W Smith, 68, a stationary engineer in Buffalo for many years, died recently. He had been stationary engineer at Buffalo Cold Storage Co, the Ellicott Square Bldg and Buffalo Athletic Club.

Dr Luther Noble Duncan, 71, president of Alabama Polytechnic Institute, died July 26 in Drake Infirmary, Auburn, following a heart attack.

W C Bradley, 84, who, until his death, held a directorship in the Georgia Power Co, died July 26 of a heart attack at his home in Columbus, Ga.

Union Electric Co of Missouri has announced receipt of the first shipment of the major parts of a new 80,000-kw turbine-generator ... be installed in its steam plant at Venice, Ill. The unit will help meet an all-time record demand for electricity in its area of operations. General Electric Co, Schenectady, N. Y., manufactured the generating unit which cost about $1,500,000.

Current peak loads of the company are in excess of 845,000 kw, more than 58,000 kw, or 7.3% above the highest wartime peak of 787,000 kw. Industrial consumption in the company's territory is running 20% above last year, while the average annual residential usage has jumped from 1309 to 1402 kwhr.

The new generator was ordered in 1941, but delivery was delayed because of World War II. It is anticipated that the unit will be in production at the Venice plant by Jan. 1948. The company has a similar unit on order for delivery in 1949. Installation is part of a $70,000,000 expansion and improvement program planned by the company for the next ten years.

From Now On We Specify

WALDRON
GEAR TYPE

Couplings

Users have learned that the design refinements of this new Waldron Coupling eliminate the chief causes of trouble and shutdowns. With no flexible hub connections to fatigue, no non-lubricated metal-to-metal contact between moving parts to cause wear, the Waldron Coupling easily proves the most economical coupling to buy and use.

Its advanced design also provides for a larger maximum bore that takes the same size shafts that heretofore required larger diameter couplings. This permits use of larger equipment, less shaft extension — a neater, more compact installation.

Waldron "Series A" Couplings are available in all popular types. Write for our Catalog 57 which gives full details, ratings, service factors, etc.

COUPLING DIVISION

JOHN **WALDRON** CORP.
Main Office and Works
New Brunswick, New Jersey
COUPLINGS

...AND LIKE IT!

"Practice what you preach" is an adage that has proved its worth at Pennsalt . . . especially at our Michigan works.

DOWNTIME SLASHED FROM 10 DAYS TO 10 HOURS!

At this plant, boiler descaling was previously done by mechanical turbining, involving shutdowns of ten days or more while the unit was being dismantled. A new method—built around our own Pennsalt PM-90 Descaling Compound—completed the entire job in *less than ten hours!* Descaling was more thorough than ever . . . in fact, Pennsalt PM-90 cleaned out pockets probably never cleaned before!

SEND FOR DETAILED REPORT ON THIS CASE!

If you are interested in technical facts on this case, write to address below for Case Report No. 69-10, which contains complete details. And if you have a problem in metal cleaning, plating, enamelling or corrosion-proof construction, call in one of our representatives and let him add our experience to your own.

PENN SALT
CHEMICALS
97 Years of Service to Industry

PENNSYLVANIA SALT MANUFACTURING COMPANY

SPECIAL CHEMICALS DIVISION, 1000 WIDENER BUILDING, PHILADELPHIA 7, PA.

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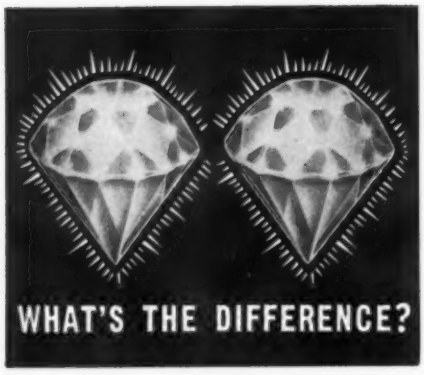


WHAT'S THE DIFFERENCE?

Both diamonds are the same size and weight, yet one is only half as valuable as the other. It takes a skilled jeweler to discover the *hidden differences.*

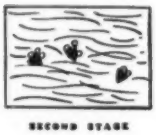
In water there are *hidden differences* too. K.A.T. was developed with this in mind . . . to simplify water treatment in any boiler. Since All-Colloidal K.A.T. functions by physical action—not chemical reaction—it is effective against all impurities in any water regardless of composition.

ALL COLLOIDAL K.A.T.® WATER TREATMENT

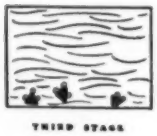
Employed as a complete or "finishing" treatment, user records show that K.A.T. improves boiler efficiency. Removes and prevents scale accumulation • Inhibits corrosion • Safeguards steam purity • Lowers fuel, labor maintenance costs • Permits almost continuous boiler operation.

K.A.T.

FIRST STAGE



SECOND STAGE



THIRD STAGE

It will pay you to test K.A.T. in your own plant today.

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USE JERGUSON TRULEVEL GAGES for Convenient, Accurate Boiler Level Readings

Sideview of Gage (Dotted line shows alternate offset arrangement available.)

HERE is a gage that gives you . . . at eye level . . . a positive reading of the height of the water in your boiler. The Jerguson Trulevel Gage is located down where you can see it, at the point most convenient for you. Wall or panel mounted.

And Jerguson adds dead sure accuracy to convenience, through precision engineering. Jerguson Trulevel Gages are provided with a new datum column which is fully steam jacketed, duplicating the temperature and specific gravity conditions which exist in the boiler drum. This guarantees *correct readings.*

Jerguson Trulevel Gages are of stainless steel construction for lifetime service. Made in three standard sizes to accommodate all pressures.

Write for Engineering Data Unit

Note These Important Additional Features:

1. Jerguson Trulevel Gage is back illuminated, easy to read. Water level stands out sharply.
2. New checking device incorporated in unit. Positive checking in matter of seconds.

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Men in the field who erect piping know when shop fabrication is well done . . . they know if the sub-assemblies fit correctly, line up easily and have all field welds or flanged joints in accessible positions. When this is the case, the erecting job is easier . . . saves both time and money.

Midwest has a Construction Department which has erected piping of all kinds for 46 years. The critical attitude of this department is the best stimulant to our four pipe-fabricating plants. The Construction Department also frequently contributes useful and practical suggestions for improving pipe fabrication.

This situation has a powerful effect in keeping the whole organization alert . . . and in encouraging continuous improvement. It is one of many reasons why you get the best when you buy Midwest Pre-Fabricated Piping . . . either as materials furnished or piping completely installed.

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Easily installed in line drive of old or new equipment. Correct speed by move of lever, for every condition. Speeds up or slows down instantly. Protects material, maintains precision, betters product. Infinite variability over wide range. *Low cost.* Used in thousands of plants.

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Also shows Variable Pulleys, Drive Sheaves, V-Belts, standard and wide, Adjustable Motor Bases, etc.

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Also Mfrs. of Lovejoy L-R Couplings

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To Help you Maintain the SAFETY ZONE LEVEL in Small Boilers and Tanks

SPECIFICATIONS

Steam pressures.....5 to 150 psi
Bottom to top of cover....12"
Bottom to top of Whistle..18"
Weight.....17 lbs.
Size of connections.....1/2"

"BROWNIE"

LOW WATER SIGNAL

Distributors and Agents in all Principal Cities

Order from your supply house or write for Bulletin 570-B.

Reliability is our first concern in making "Brownie" Low Water Signals. We recognize also the importance of a reasonable price. These two features of the "Brownie" are the result of a construction that provides reliability and convenience for users and economy in manufacture.

Quick-acting float-operated whistle warns of low water level in advance of a dangerous condition. Simple to install. Designed for long trouble-free service.

WRIGHT — AUSTIN COMPANY
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SERVING INDUSTRY FOR MORE THAN 50 YEARS

REMOVE SOOT and firescale with **XZIT** from all boiler surfaces—tubes, walls and stacks.

XZIT Firescale and Soot Eradicator saves fuel by improving heat transfer.

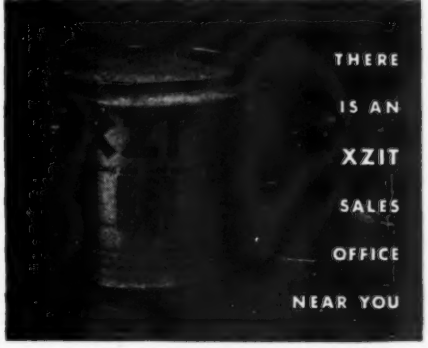
XZIT does its work while boilers operate.

Simply feed **XZIT** into the firebox.

When touched by flame, **XZIT** forms a gas which permeates all parts of boiler and removes soot and firescale.

Regular use of **XZIT keeps boilers & stacks free of soot & firescale.**

Ask for a demonstration or order a trial supply.



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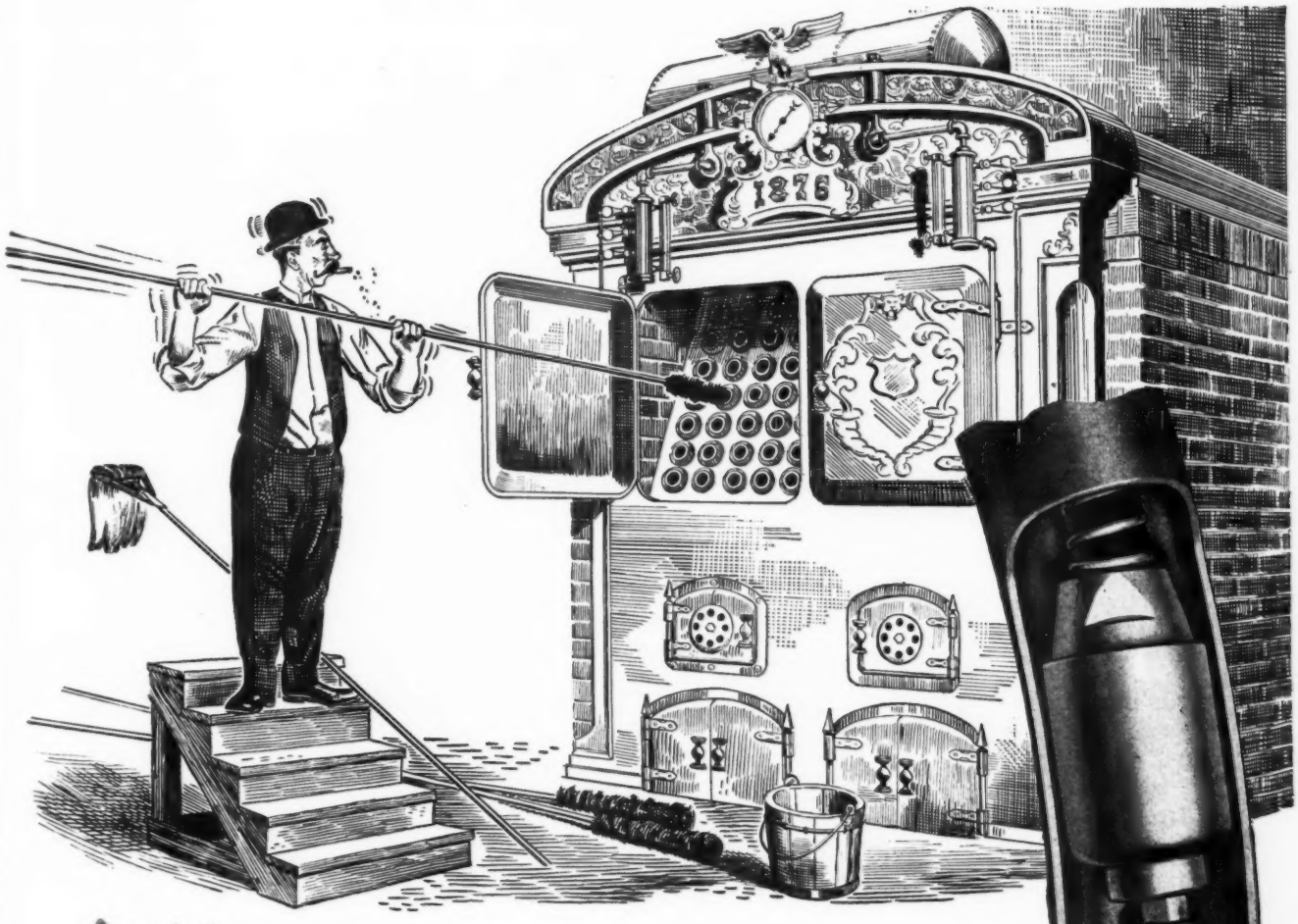
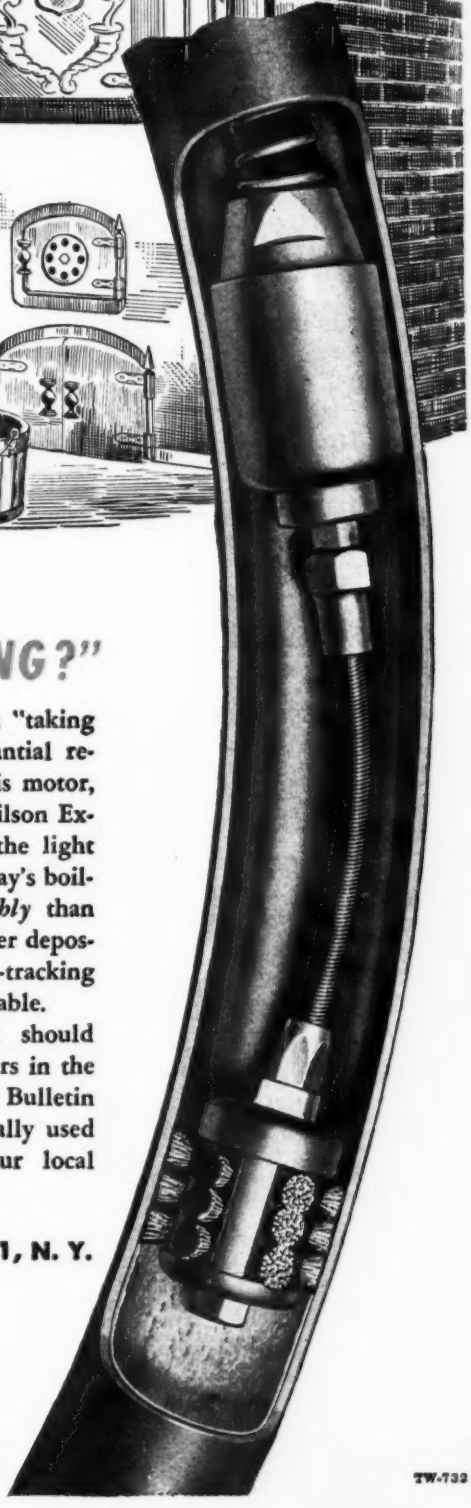


What...NO WEEKLY CLEANING?"

Weekly tube cleaning went out with horse-drawn cars and mustache cups. Today's boiler designs and feedwater treatment have improved greatly. Tubes don't scale up as fast. But when scale *does* accumulate, it presents a bigger problem than ever before—bigger because boiler temperatures and pressures are higher—tube failures can be more disastrous. Bigger, too, because boiler down-time and repair-time are increasingly expensive in view of today's rising costs.

That's why fast acting Wilson Tube Cleaners are found in more and more modern boiler plants. The Wilson ECT Series Air Motor, for instance, develops up to 40% more power when "taking the curves", permitting substantial reductions in cleaning time. This motor, together with the patented Wilson Expanding Brush, will remove the light powdery deposits found in today's boilers *faster* and *more thoroughly* than any other cleaner. When heavier deposits are found, speedy non-tracking Wilson Cutter Heads are available.

Every modern boiler plant should have fast Wilson Tube Cleaners in the tool room. Why not write for Bulletin 47 describing the more generally used Wilson Cleaners, or see your local Wilson Representative?



THOMAS C. WILSON, INC. • 21-11 44th Avenue, Long Island City 1, N. Y.
Cable address: "TUBECLEAN", New York

WILSON
TUBE CLEANERS

TW-732

TO HELP YOU WITH FUTURE POWER PLANNING

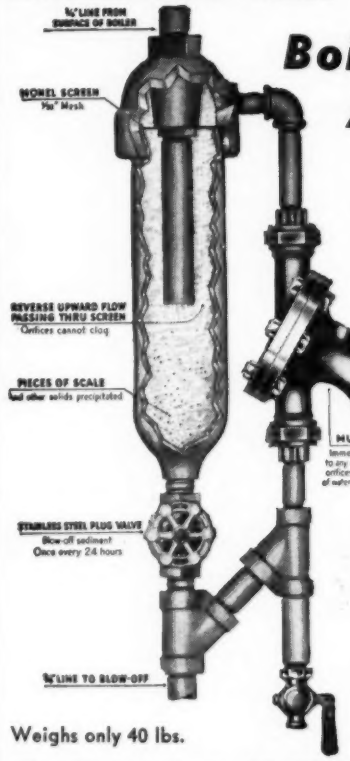
Special section on

FEEDWATER TREATMENT

DECEMBER—POWER

32 pages summarizing the latest developments in this field.

MULTOMETER SYSTEM CONTINUOUS BOILER BLOW-OFF


¾" LINE FROM SURFACE OF BOILER
MONEL SCREEN 16 Mesh
REVERSE UPWARD FLOW PASSING THRU SCREEN
Orifices cannot clog
PIECES OF SCALE and other solids precipitated
MULTOMETER
Immediately adjustable to any one of nine different orifices to meet any condition of water or variation in boiler load
STAINLESS STEEL PLUG VALVE
Blow-off sediment Once every 24 hours
¾" LINE TO BLOW-OFF

Weighs only 40 lbs.

Boilers kept clean . . . ALL THE TIME

- Impurities and sludge removed continuously as accumulated.
- Boiler concentration and chemical balance maintained as desired.
- Fuel costs reduced.
- Maintenance and operation savings.
- An end to wet steam, foaming, and priming.
- Increased efficiency of steam generation.

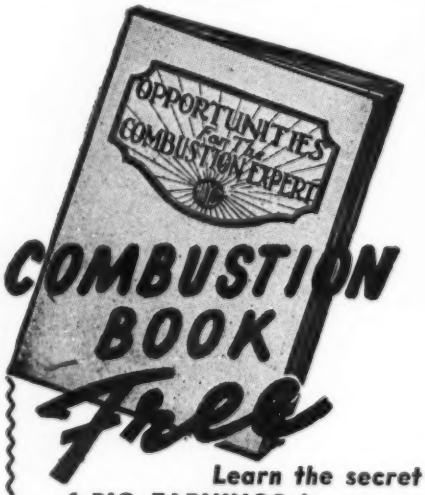
• Engineered for use with every kind and size of boiler and every character of feed water.

The only continuous boiler blow-off which will neither cut out nor wear out in regular service.

A survey of your operation, including analyses of both feed water and boiler water, is available without cost or obligation.

P. E. MADDEN & COMPANY

352 W. WALTON ST. CHICAGO 10, ILL.



Learn the secret

of BIG EARNINGS in . . . . COMBUSTION ENGINEERING

There are plenty of good pay jobs in the power field today. Increase your earnings now—be a Hays-Trained Combustion Engineer. Just a little of your spare time required for the simple, easy-reading Hays Home Study Course. Hundreds of others have made better jobs for themselves through Hays training. So can YOU.

Approved for GI. Write for Free Book Now!

Hays Institute of Combustion
430 N. Michigan Ave., Chicago 11, Ill.
(Dept 110) Our 28th Consecutive year

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Name .....
Address .....
City ..... State .....
Company Name .....

VIKING

The MARK OF A GOOD RELIABLE ROTARY PUMP

VIKING PUMPS — "GEARED WITHIN A GEAR" — JUST 2 MOVING PARTS — REG. T.M. IN U.S.A. — VIKING PUMP CO. CEDAR FALLS, IOWA

Look for this registered trade mark and the name VIKING on all your rotary pumps. It is your assurance of a good, reliable pump for handling fuel oils, lubes and greases.

It means you have a pump based on the design of more than a million others. Built from sound rotary pump experience and know-how unsurpassed in the field.

Look to Viking, the rotary pump manufacturer who builds to serve you now and in the future. Be safe. Be sure. Buy Viking. Write today for free bulletin 46SW.

See Our Catalog In SWEETS

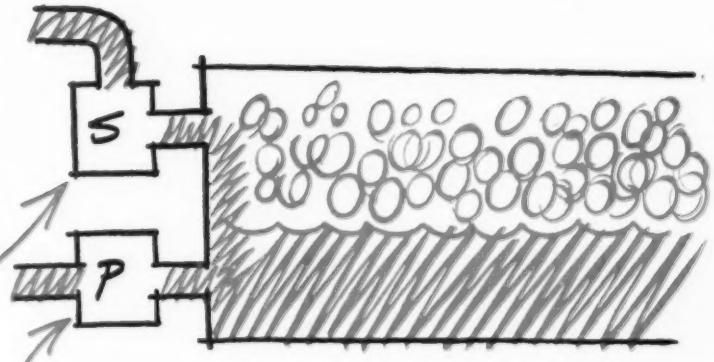
VIKING PUMP COMPANY

CEDAR FALLS, IOWA

LUBE MEMO

Air bubbles can wreck bearings

In our dry-sump system, air sucked through scavenging pump makes lube foam.



When foam gets into pressure pump, it loses suction, pumps insufficient oil to bearings...!!

Rep. says RPM DELO Diesel Engine Lubricating Oil stops foaming—How?

1. Special compounds in RPM DELO Oil minimize bubbles.
2. Lab. tests prove bubbles that form break up immediately

Phone RPM Delo Oil Rep.

DIESEL ENGINE RPM DELO LUBRICATING OIL

STANDARD OF CALIFORNIA • San Francisco, Calif.
THE CALIFORNIA COMPANY • Denver, Colo.
THE CALIFORNIA OIL COMPANY • New York
STANDARD OF TEXAS • El Paso, Texas

Are your corrosive fluid-line valves *assets* or *liabilities?*

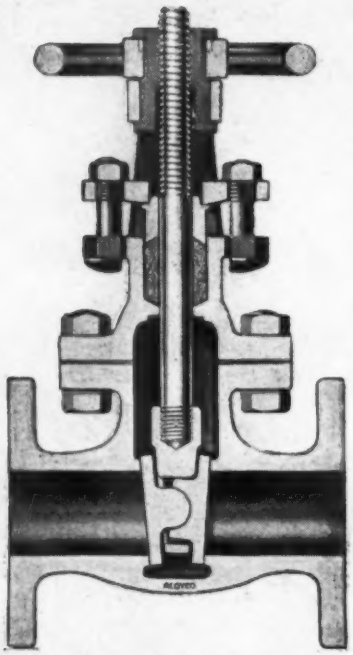
IN corrosive fluid service, a valve is an asset or a liability, depending upon whether or not it always operates positively and lasts for a long period without costly maintenance.

As the Chief Engineer in a large process plant told us recently: "The batches in those kettles are worth as much as $5,000 each. If a valve should stick at the wrong moment, we might lose several thousand dollars. That is why we have to have valves that always operate positively and valves that last. We have never known an Aloyco Valve to stick and they seem to last forever. That is why all new pipe lines and all valve replacements in old pipe lines are Aloyco in this plant, and will be as long as I am chief engineer."

Aloyco manufactures only corrosion resistant valves and fittings. If you want the best valve in the right alloy for your particular application, consult us.

No. 111 GATE

The leader of corrosion resistant valves.



Sectional View of No. 111 Gate Valve showing double-disc, ball-and-socket wedge.

ALOYCO

STAINLESS STEEL VALVES AND FITTINGS

GATE, GLOBE, Y, CHECK, TANK, SAMPLING AND V-PORT VALVES
SCREWED, FLANGED AND WELDED FITTINGS

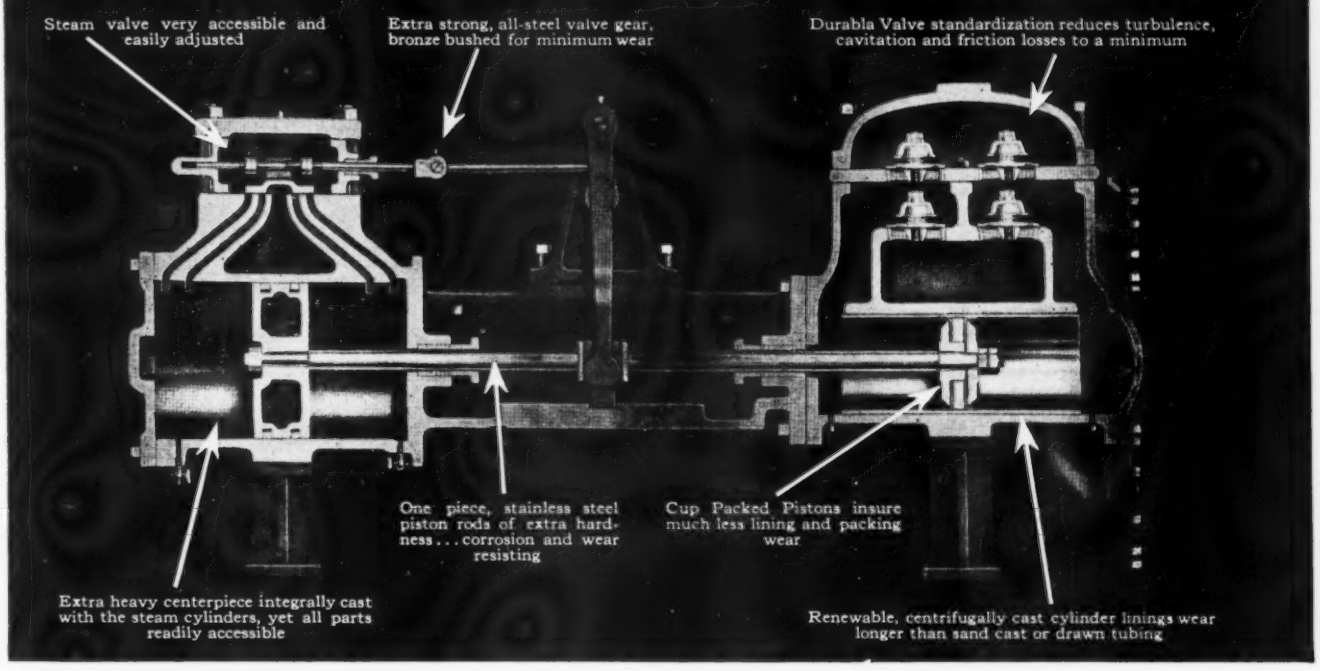
ALLOY STEEL PRODUCTS COMPANY, INC.

1403 WEST ELIZABETH AVE. • LINDEN, N. J.

A TYPICAL EXAMPLE OF

Superior Pump Engineering

WARREN REALWEAR STEAM PUMP


Steam valve very accessible and easily adjusted
Extra strong, all-steel valve gear, bronze bushed for minimum wear
Durabla Valve standardization reduces turbulence, cavitation and friction losses to a minimum
One piece, stainless steel piston rods of extra hardness... corrosion and wear resisting
Cup Packed Pistons insure much less lining and packing wear
Extra heavy centerpiece integrally cast with the steam cylinders, yet all parts readily accessible
Renewable, centrifugally cast cylinder linings wear longer than sand cast or drawn tubing

THE Warren "Realwear" is an example of engineering from *your* viewpoint. Notice the plus features in the cutaway view above. Compare with any similar make.

This is the type of engineering that goes into *every* Warren pump—both reciprocating and centrifugal. Dependability, maintained efficiency with low maintenance costs are first considerations. Let us talk with you about your next pumping problem. Write:

WARREN STEAM PUMP COMPANY, INC.
Warren, Massachusetts

Atlanta Boston Chicago Cleveland Denver Detroit Houston
Manchester, Conn. Los Angeles Minneapolis New Orleans New York
Philadelphia Pittsburgh Richmond San Francisco Seattle St. Louis

Warren Pumps

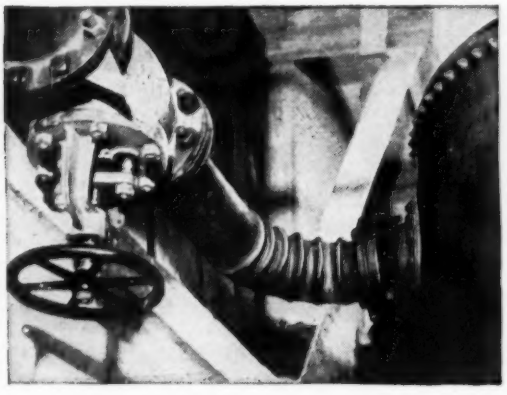
CENTRIFUGAL AND RECIPROCATING

P-10

1897 — OUR FIFTIETH ANNIVERSARY — 1947

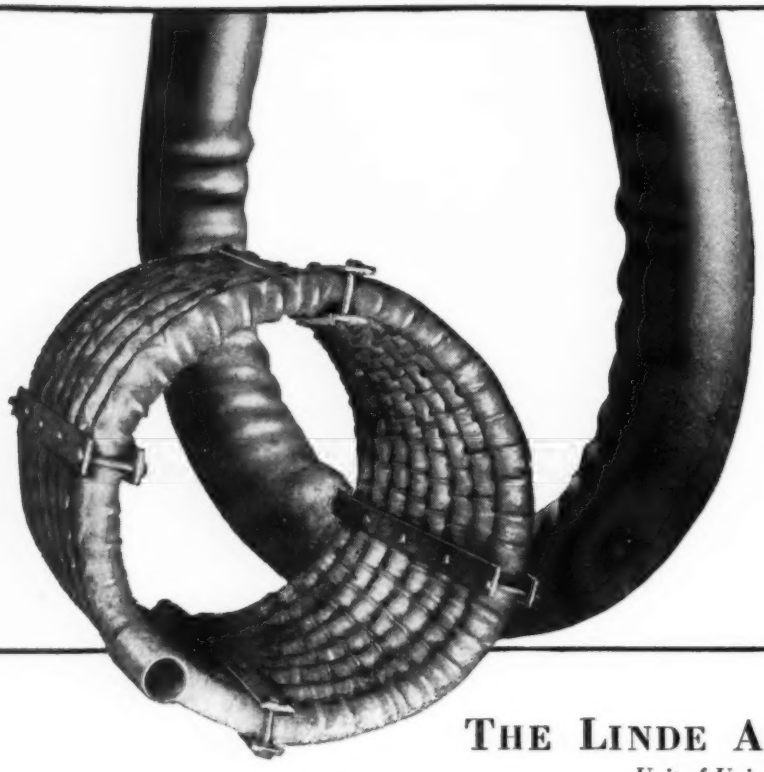
"Tailor-Made" Bends

Where compound bends are required in a continuous section of pipe, wrinkle-bends offer an ideal solution. Wrinkle-bends are leakproof, as strong as the pipe itself, require no maintenance, and are easy to insulate.



This short-radius wrinkle-bend joins a compressed air line to a reservoir. Wrinkle-bends can be made in brass, copper, aluminum, and steel pipe from 2 inches to 26 inches in diameter.

Pipe bends can be made right on the spot with the aid of an oxy-acetylene welding or heating blowpipe, a simple bending rig, and a few common tools. Wrinkle-bending does not reduce the thickness of pipe walls.



This condenser coil made from 2-inch stainless steel pipe has 350 wrinkle-bends.

There are many LINDE methods for forming, cutting, joining, and treating metals. LINDE engineering service is always on call to help customers with production and maintenance jobs. Just call the nearest LINDE office.

The word "Linde" is a registered trade-mark of The Linde Air Products Company.

See HELIARC and UNIONMELT *Welding Demonstrations*
Area No. 838 & 840
National Metal Exposition
Chicago, October 18 to 24

Linde

THE LINDE AIR PRODUCTS COMPANY

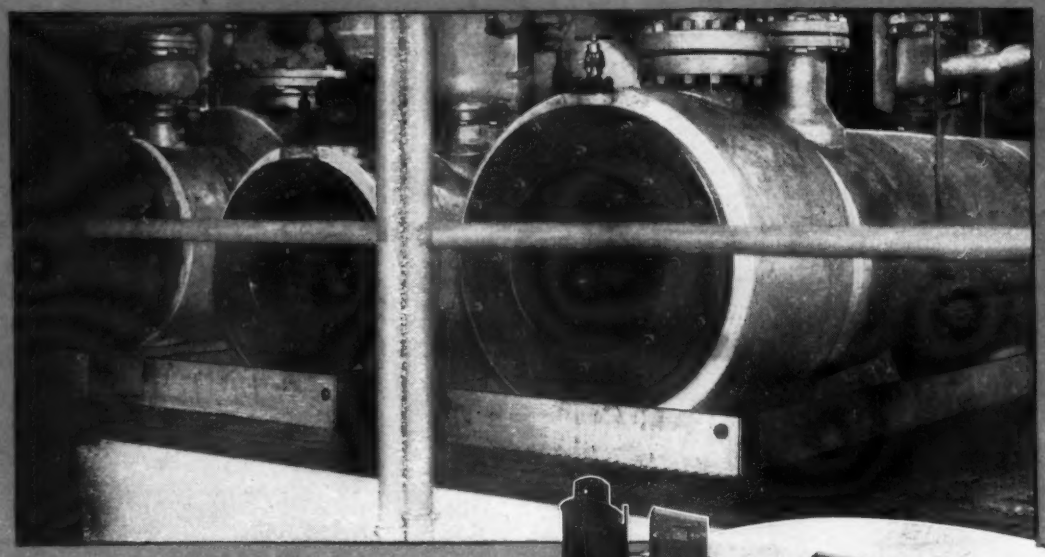
Unit of Union Carbide and Carbon Corporation

30 East 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities
In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto

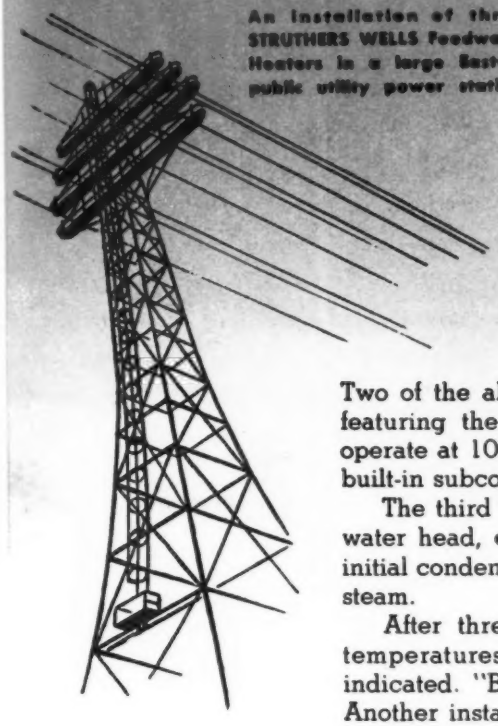
SW STRUTHERS WELLS

feedwater HEATERS

FOR HIGH PRESSURE SERVICE



An installation of three STRUTHERS WELLS Feedwater Heaters in a large Eastern public utility power station.



Two of the above FEEDWATER HEATERS are high pressure units, featuring the STRUTHERS WELLS' "Boltless Head" closure, and operate at 1000 lbs. pressure. One of these heaters also includes a built-in subcooling section.

The third unit is a low pressure heater with conventional bolted water head, employing a steam distribution belt to afford sufficient initial condensing surface to most effectively handle the low pressure steam.

After three years of constant service without cleaning, outlet temperatures had only dropped a few degrees, cleaning was indicated. "Boltless Head" closures have been proven trouble-free. Another installation is now being made for the same company at a new plant.

Write for descriptive, technical Bulletin No. B-17.

STRUTHERS WELLS CORPORATION

Process Equipment Division

WARREN, PENNA.

PLANTS AT WARREN, PENNA. AND TITUSVILLE, PENNA.

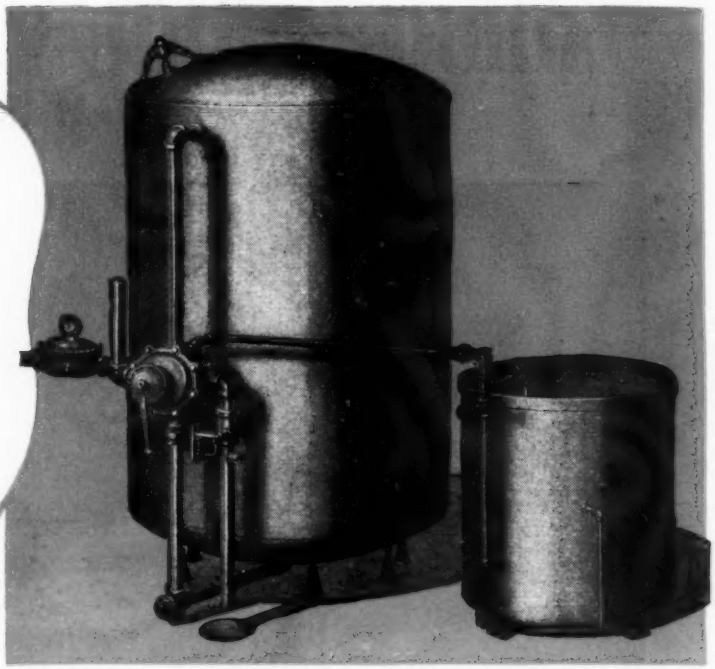
21,000 EXTRA GALLONS

of soft water per regeneration!

That's what the

ELGIN WATER SOFTENER

gives at no extra cost!

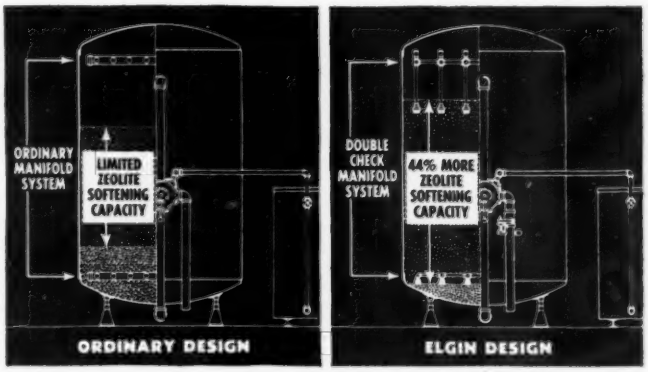


There's no secret about it! The drawings show the big improvement in the Elgin Water Softener that does the trick . . . gives you up to 44% more soft water . . . for example, 21,000 more gallons per regeneration from a 42" x 72" softener handling ten-grain water than is delivered by the ordinary water softener.

This basic improvement is the Elgin "Double-Check" arrangement. It's one of those why-didn't-someone-think-of-it-before ideas—a manifold arrangement which prevents the escape of zeolite under all operating conditions. By so doing it permits a far deeper bed of zeolite in a softener of given size, and of course more zeolite means more soft water output. Also, by preventing zeolite loss, a higher backwash rate is made possible. This cleans and opens up the zeolite bed thoroughly —means better and quicker regeneration with less salt consumption.

There's no question about it! The story of extra gallons of soft water is being told in daily service by Elgin "Double-Check" installations in more than 3000 plants. Their ability to save dollars in first cost, in operating cost, in maintenance cost is indelibly written into the records of plants like yours.

And note this: Existing softeners, regardless of make, can be modernized by Elgin to incorporate the features and advantages of this "Double-Check" design.



Whatever your water conditioning problem Elgin has the answer—While the Elgin "Double-Check" Softener represents the zeolite water softener at its best, it is not the answer to every water conditioning problem. Such is the scope of Elgin equipment and methods, however, that we are in a position to give you an unprejudiced recommendation covering your particular needs. One of our district engineers would like to show you how we can solve your problem. No obligation whatever.

Ask for this new bulletin—It describes the design and advantages of this revolutionary water softener.

ELGIN SOFTENER CORPORATION

130 N. GROVE AVE., ELGIN, ILLINOIS

SOFTENERS ★ FILTERS ★ WATER TREATMENT ★ BOILER WATER CONDITIONING

CONSERVATIVE DESIGN *means*

FURNACES . . .

with sufficient volume and watercooling to satisfactorily burn the full range of coals economically available in your locality for the next 25 years.

PULVERIZERS . . .

of sufficient capacity to maintain design rating of steam units with hardest structure coals.

STOKERS . . .

with sufficient grate area to avoid excessive fuel bed temperatures.

A New Era in Design

These modern postwar units ranging in size from 10,000 to 1,000,000 pounds of steam per hour were designed from the ground up for WIDE FUEL FLEXIBILITY.

To protect against any contingency of normal and abnormal coal supply, practically all these modern installations were designed to conform to the following basic maximum and minimum fuel specifications. *These specifications are not actual coal analyses.* Instead, they are tolerance values, which provide factors of safety to assure high capacity, troublefree, economical operation with a wide range of coals.

As a result, furnaces were designed with sufficient volume and watercooling so that (furnace) exit-gas temperatures will not exceed ash-fusion temperatures *on the oxidizing basis*. Likewise the units have ample pulverizer capacity, or stoker grate area, to insure adequate fuel flexibility.

FUEL SPECIFICATIONS

Basic Maximum and Minimum Values

Maximum Moisture	10%
Maximum Volatile	38%
Maximum Ash	12%
Maximum Sulphur	3.5%
Minimum Grindability (Hardgrove)	50
Minimum Ash-Softening Temperature	2000 F

FAIRMONT COAL BUREAU, Chanin Bldg., 122 E. 42nd St., New York 17, N.Y.

Write for Reference Bulletin No. 10 for more complete information on these 600 installations. Your request will automatically put your name on the Bureau's mailing list.

Name_____ Position_____

Company_____

Street Address_____ City_____ Zone____ State_____

FAIRMONT COAL BUREAU · FAIRMONT REGION · WEST VIRGINIA · SERVICE TO INDUSTRY ·

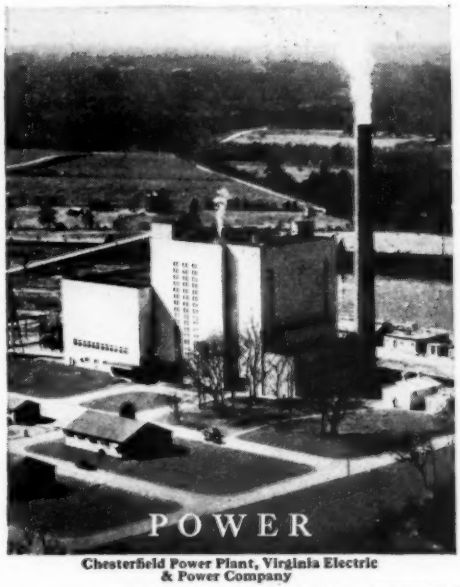
P 10-'47

Chase Brass & Copper Company, Euclid, Ohio

SPECIALIZED KNOWLEDGE IN DIVERSIFIED FIELDS

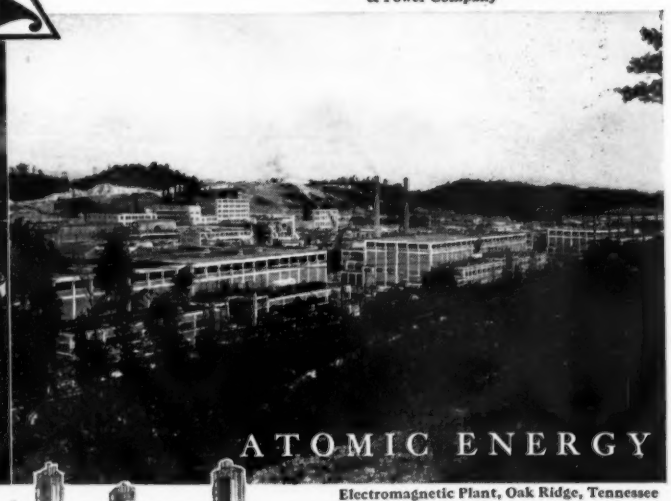
Proposed Children's Medical Center, Boston, Mass.

Since 1889, Stone & Webster Engineering Corporation has been engaged in the solution of design, engineering and construction problems. This experience is available to companies looking toward the future.

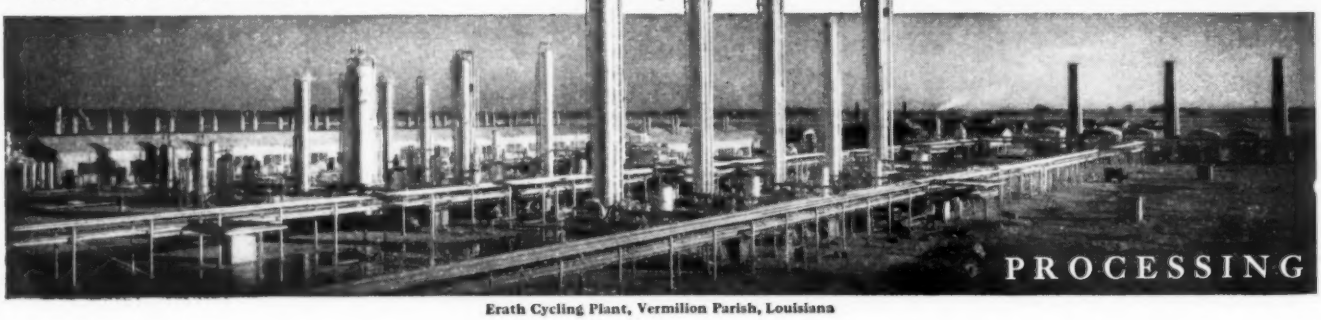


Chesterfield Power Plant, Virginia Electric & Power Company

Tennessee Valley Authority Ammonia Plant



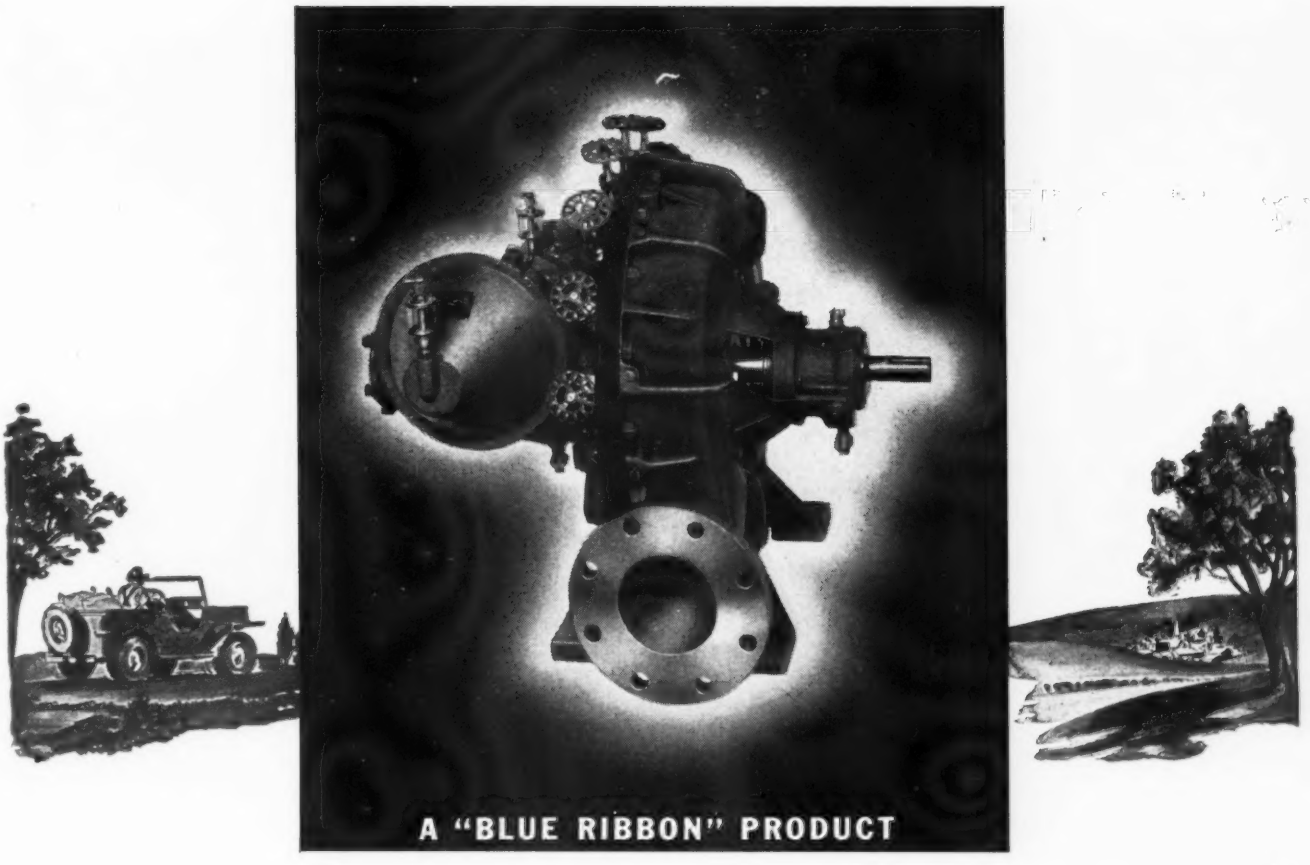
Electromagnetic Plant, Oak Ridge, Tennessee



Erath Cycling Plant, Vermilion Parish, Louisiana

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER INC.



THEY CALL 'EM JEEPS

BECAUSE THEY'RE SMALL, BUT POWERFUL, AND GO ANYWHERE

For a small, tough, hard-working turbine that will go anywhere and do all you expect of it . . . get a Coppus "Blue Ribbon" Steam Turbine.

Coppus Steam Turbines come in six frame sizes from 150 HP down to fractional—so you can match more closely your job requirements. Each smaller size is priced correspondingly less, so by selecting "horsepower" instead of "elephant power" you save on investment and installation cost.

Many well-known manufacturers install Coppus "Blue Ribbon" Steam Turbines on original equipment. They know Coppus quality will protect the reputation of their own products. The Coppus Turbine is also being used on many U. S. Destroyer Escorts, all Casablanca class aircraft carriers and 90% of all Landing Ship Docks.

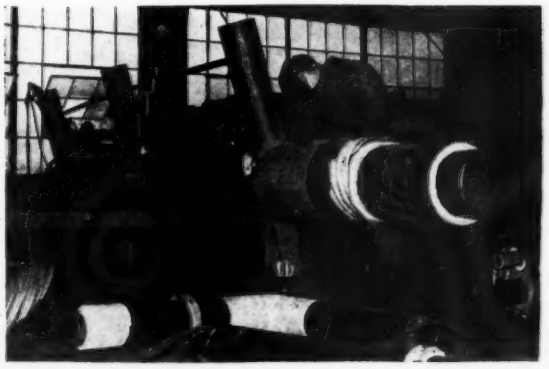
Like all Coppus "Blue Ribbon" products (blowers, ventilators, gas burners, etc.), the Coppus Steam Turbine is a precision-made product, with accuracy controlled by Johansson size blocks. Every turbine is dynamometer-tested before shipment.

More than 85% of all orders since 1937 have been repeat orders.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

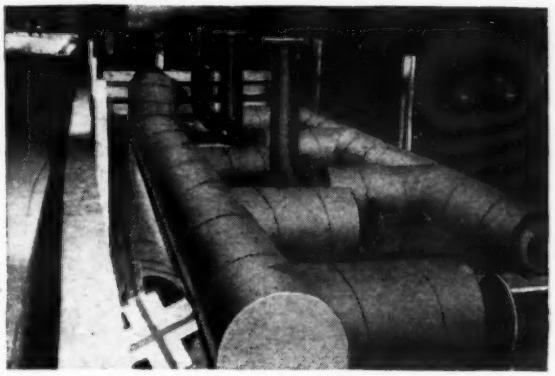
Write for Bulletin 135-9. Coppus Engineering Corporation, 170 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

Pre-Insulated FABRICATED PIPING *Pre-Sealed*



Units are completely fabricated and insulated at the Ric-wiL plant . . .

and are shipped ready to install with single-handling upon arrival.



by RIC-WIL

FOR OUTDOOR USE
Underground or Overhead

● An exclusive, outstanding feature of Ric-wiL Pipe Units is the fact that they are not only prefabricated but are also completely *insulated* in the Ric-wiL plant and are shipped ready for immediate, *single-handling* installation, per plans and specifications.

Ric-wiL Foilclad Units, with pipe and insulation coated with asphalt and wrapped with aluminum or copper foil, are supplied for overhead single-pipe lines. For underground lines or overhead multiple pipe systems, or wherever high strength conduit is required, Ric-wiL supplies units in which piping and insulation are housed in Helcor conduit. This helically corrugated galvanized iron conduit is full welded and pressure tight and covered with a heavy coating of asphalt and a wrapping of asphalt saturated asbestos for complete protection.

Either type unit is furnished complete with expansion loops, fittings, etc., in the same design, ready for field installation in minimum time and at minimum cost. In multiple pipe units, pipes may be insulated from each other or from the exterior only, as in the type of unit used for transmission of oil and process liquids. No matter how complicated the requirements of an individual job, Ric-wiL is equipped to prefabricate and insulate in the factory, to meet individual plans and specifications.

The insulated pipe headers shown above are typical examples. Designed for a system of piping actified and foul solutions, they required special insulating and cutting, mitering and welding of pipe with flanges and conduit. One 28 ft. unit comprises 3 tee branches, 1 Y branch, 2 reducers and 4 slip-on flanges welded to the pipe. Only work required at job-site was simple connection of header to adjacent equipment.

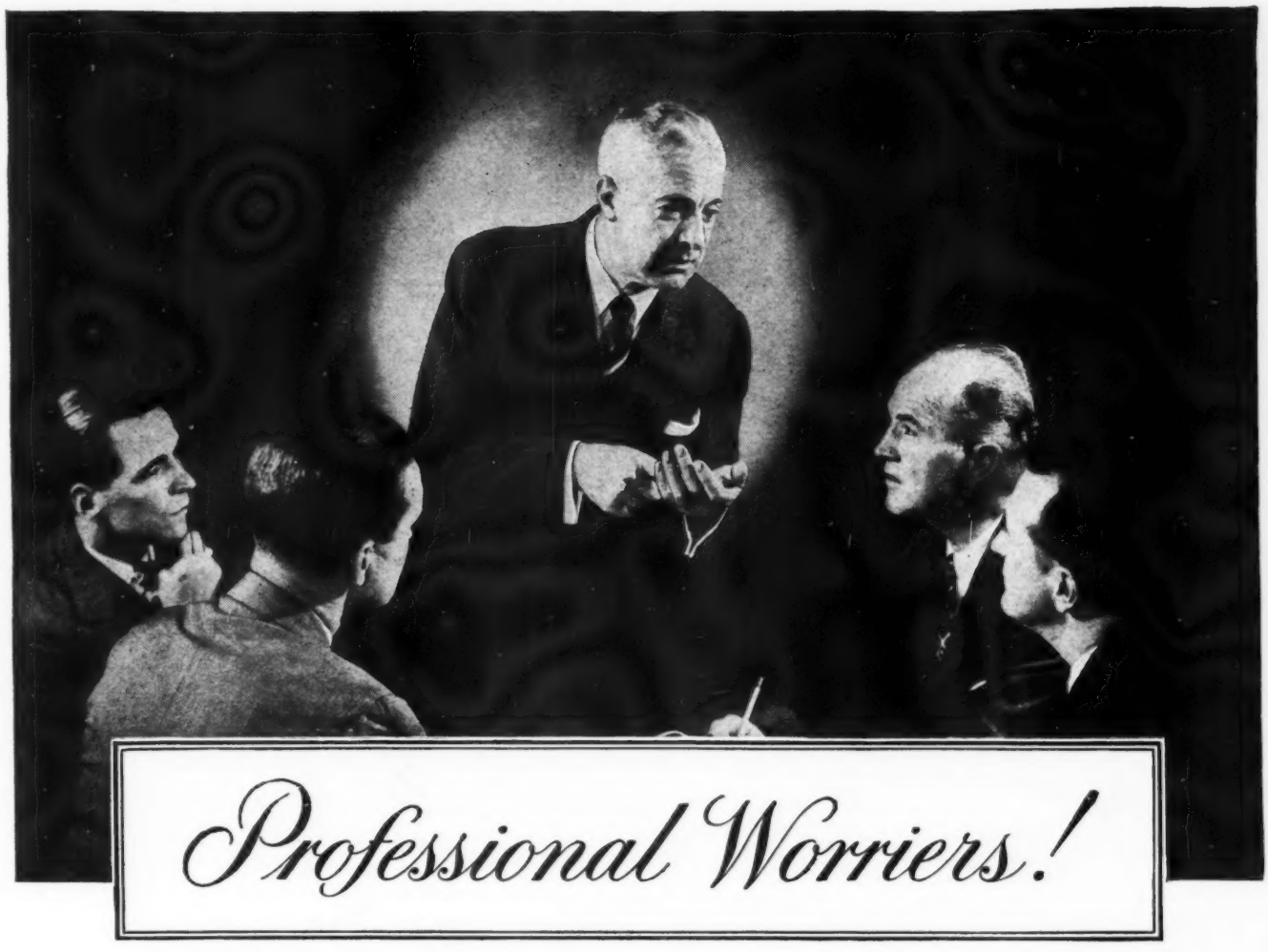
If you have overhead or underground piping problems, write for complete information.

RIC-WIL

INSULATED PIPE CONDUIT SYSTEMS

THE RIC-WIL COMPANY · CLEVELAND, OHIO

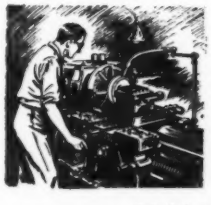
CABLE ADDRESS: RICWIL, BENTLEY'S CODE



Professional Worriers!

Every business, time and again, runs into production snags. When the problem is *lubrication*, we're often called in to do the worrying. And eight times out of ten we come up with the right answer—*fast*. Because that's our job day in, day out, year after year—putting petroleum to work *efficiently*. This backlog of experience, coupled with the world's finest lubricants and fuels, is your best reason for calling Cities Service next time trouble calls on you.

CITIES SERVICE STOPPED TROUBLE HERE!



A screw products company in Cuyahoga Falls, Ohio, called on Cities Service for advice on machining a part of an intricate mechanism made of aluminum that required extreme accuracy and finish. Chillo Oil No. 22 was recommended. Thereafter, the manufacturer reported the machined work was not only well within the required tolerances, but the work had a mirror-like finish. Tool life was also phenomenally good.

A brick and tile company in Iowa suffered numerous failures of the main drive-shaft bearings in their Hammer Mill Crushers. Cities Service engineers recommended Pacemaker Oil No. 2. The last report from the company said that since they standardized on this lubricant, no bearing failures have occurred.

"We use Solvent No. 26 for cleaning surplus oil and grease out of electric clock movements and we find it unexcelled for this purpose" ...so writes the president of an Illinois watch repairing and rebuilding concern after continued use of this remarkable new Cities Service metal cleaning fluid.

A bus company executive in Cleveland, Ohio, recently said, "During the past four years, we used Cities Service Heavy Duty type oil with outstanding results—minimum wear, freedom from sludge and no engine failures—which has enabled us to give uninterrupted service to our customers."

CITIES SERVICE OIL CO.
New York—Chicago

CITIES SERVICE

ARKANSAS FUEL OIL CO.
Shreveport, La.

Cities Service Oil Company
Room 232, Sixty Wall Tower
New York 5, N. Y.

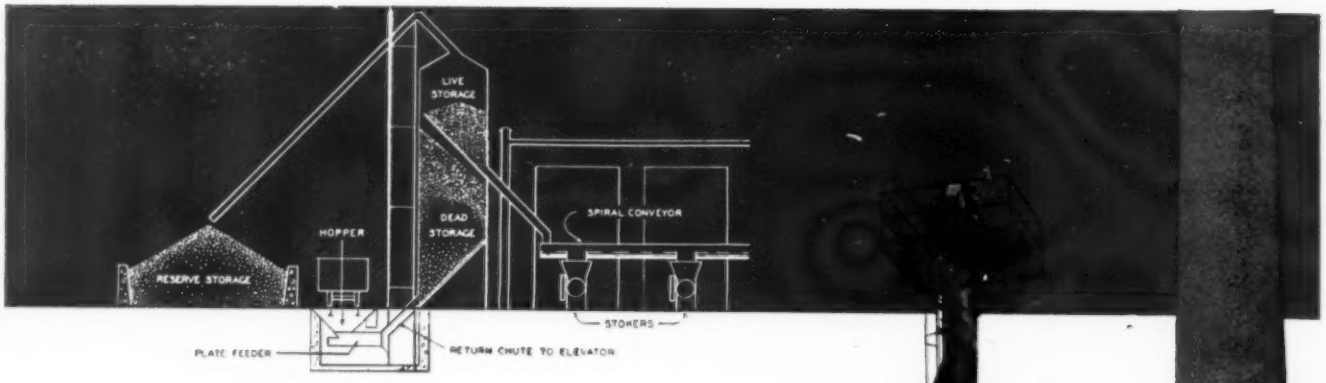
Gentlemen: I have a production problem that involves lubrication. I would like to discuss it with one of your lubrication engineers, without obligation, of course.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____



ENCLOSED STORAGE WITH SPIRAL FEED

Here's another typical Jeffrey installation with the advantages of handling large capacities in minimum space. For this and other coal and ash handling economies our Power Plant equipment Catalog No. 778 will come in handy. Send for your copy TODAY.

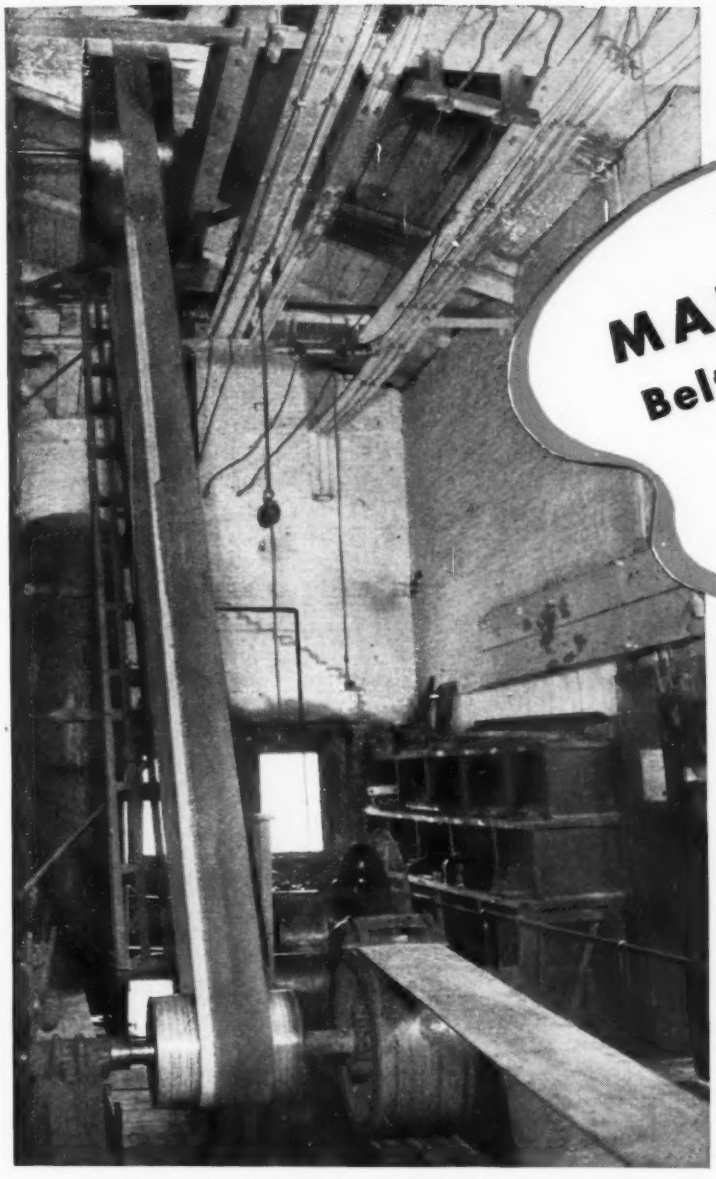
A Jeffrey spiral Conveyor delivers directly to stokers from the silo chute (see drawing above). Alternate methods utilize apron feeders, electric vibrating feeders, belt conveyors, skip hoists or weigh larries.

THE JEFFREY MANUFACTURING COMPANY

932-99 North Fourth St., Columbus 16, Ohio

ESTABLISHED 1877

Complete Line of Material Handling, Processing and Mining Equipment



This MANHATTAN Belt . . . gave 22 years continuous service

. . . traveled 1,448,864 miles

The 18-inch, 5-ply Manhattan Transmission Belt pictured here was held in storage over 4 years, followed by 22 *years* of actual service. It operated a line shaft in the machine shop of the Huntington and Broad Top Mountain Railroad and Coal Company. This drive is nearly vertical which means that a higher than normal belt tension had to be maintained to prevent slip.

We quote directly from a letter from Mr. F. E. Steele, Superintendent:

> "It is my personal opinion that this is a remarkable service for a belt of this type when we take into consideration the fact that drive pulley was 14 inches in diameter. This within itself would throw considerable strain on a belt of this width and weight, also with a speed of approximately 2,383 feet per minute. During this period of operation we had no trouble whatsoever and at all times the belt worked very satisfactorily."

A lacer accident finally ended its career.

> "Should this accident not have happened, the belt would still be in service and doing a good job."

This is one of many case histories to which Manhattan can point for proof of Workmanship and Quality Materials . . . reasons why Manhattan has long been famous for its belts. Whatever the job, there's a Manhattan Belt that will lower *your* costs, too.

A SINGLE SOURCE for a COMPLETE BELTING LINE

Manhattan offers a range of four driving tension surfaces on rubber transmission belts. Also Endless Cord, Non-Spark, Oil-Proof and Acid-Proof constructions. Belts can be factory-made endless or field vulcanized by the Condor-Weld method. All Manhattan endless belts have the patented Extensible-Tip outer-ply splice which prolongs belt life considerably. Literature on request.

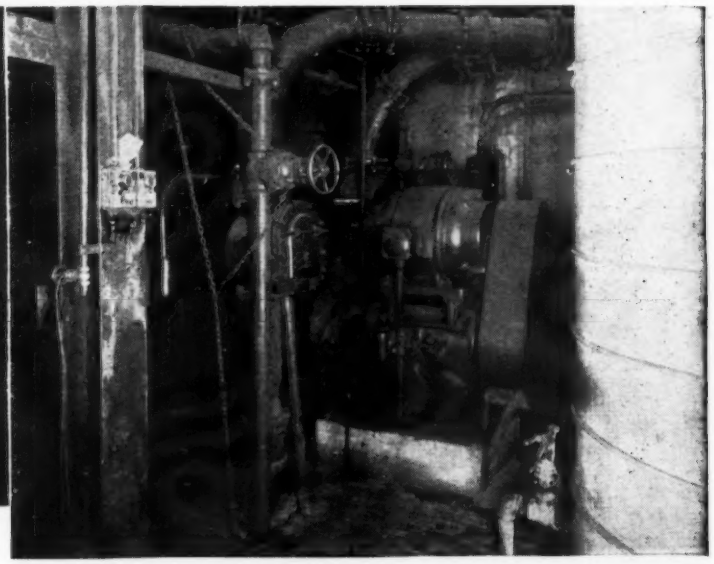
RAYBESTOS R M MANHATTAN

RAYBESTOS-MANHATTAN INC.

Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION PASSAIC, NEW JERSEY

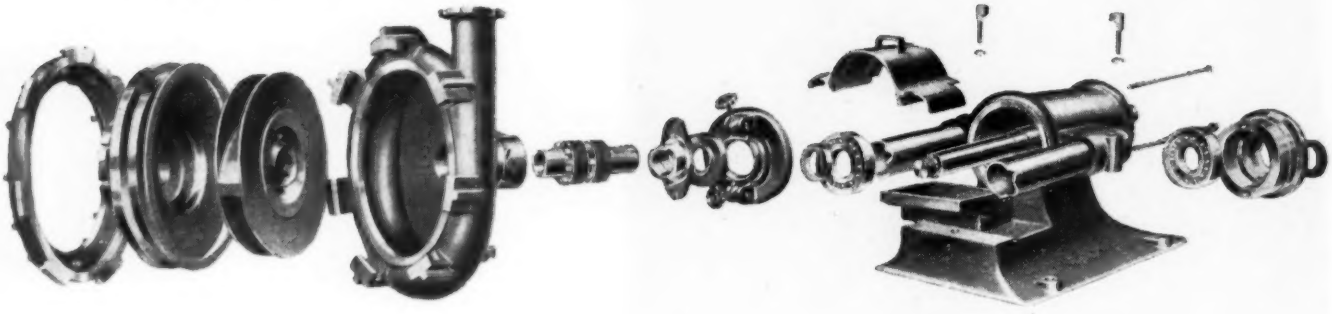
2-WAY REDUCTION IN MAINTENANCE PROBLEMS



WITH

AMSCO-NAGLE

INDUSTRIAL PUMPS



TOUGH JOBS DON'T FAZE AMSCO-NAGLE

Pump-punishing removal of ashes poses a maintenance problem — it's simplified in this large midwestern power plant by installing an Amsco-Nagle, "8", Type "T", Ball Bearing Industrial Pump as shown above. Less maintenance required because design and materials are pointed at maximum service under toughest operating conditions. Maintenance, when required, is reduced to simplest form by accessibility of all parts. Write for bulletins.

REDUCTION NO. 1
LESS MAINTENANCE

Maximum service life assured with Amsco-Nagle Pumps because they're designed to resist abrasion, and impact. Wide impeller clearances pass debris-laden liquids. Only casing, impeller, end plate contact material being pumped. Anti-friction bearings completely sealed off from water end. Manganese steel impellers and casings used for unequalled resistance to impact and abrasion.

REDUCTION NO. 2
EASIER MAINTENANCE

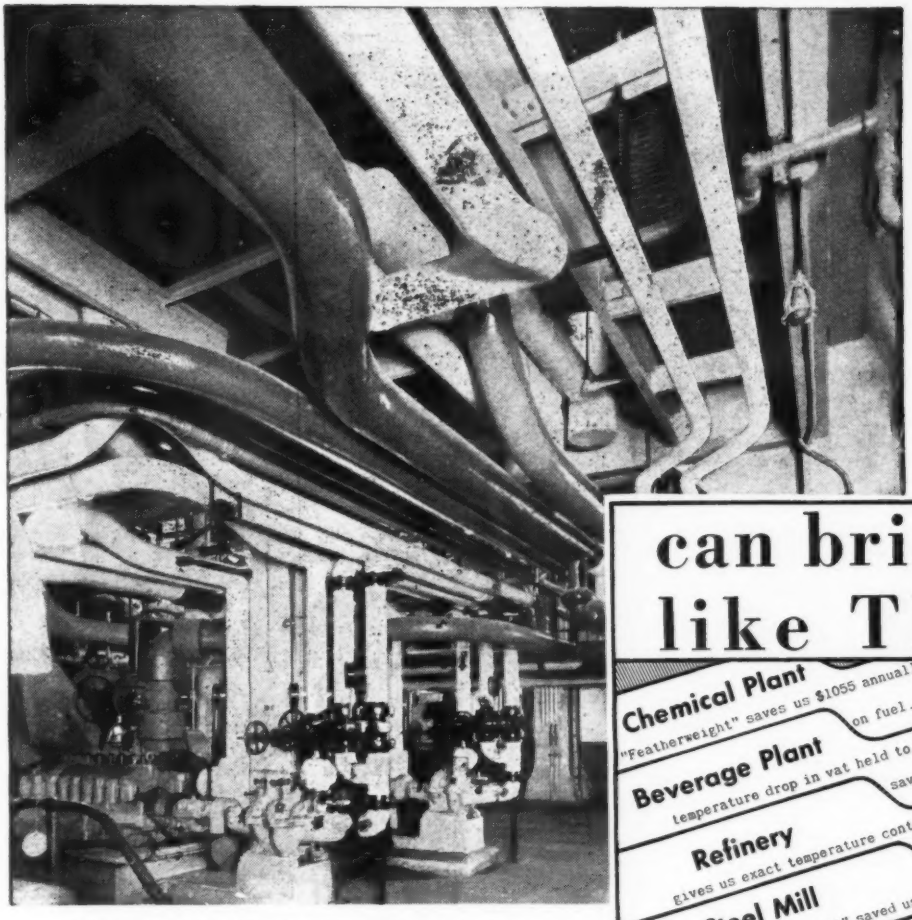
Accessibility of all parts simplifies maintenance — reduces non-operating time to a minimum. End plate attaches with clamping ring or dogs, impeller screws on. Supporting tubes on water end slip into sleeves on bearing housing. Stuffing box quickly reached from above or below, between supporting tubes.

AMERICAN Brake Shoe COMPANY

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILL.

Foundries at Chicago Heights, Ill., New Castle, Del., Denver, Colo., Oakland, Calif., Los Angeles, Calif., St. Louis, Mo.
Offices in principal cities. In Canada: Joliette Steel Limited, Joliette, Que.

. . . how the right INSULATION . . .



Condenser room of a large midwestern utility. As is customary in many plants, some of the lines have been painted to identify service.

can bring results like THIS . . . .

Chemical Plant
"Featherweight" saves us $1055 annually on fuel. We are very pleas

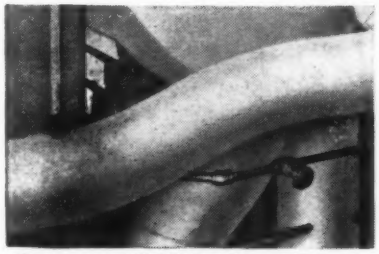
Beverage Plant
temperature drop in vat held to 1° in 64-hour weekend shutdown. saved us considerable time and fuel when we resumed

Refinery
gives us exact temperature control, enormous fuel savings. In our plant this is a matter of vital concern.

Steel Mill
"Featherweight" saved us $1750 in one month. We expect to find similar savings in the months and years to come.

Process Industry
1,500,000 BTU's saved every day with "Featherweight" 85% Magnesia pipe insulation.
...erature drop in vat he... ...wed us consi...

K & M "Featherweight" 85% Magnesia



Closeup view of K & M 85% Magnesia Insulation, complete with Canvas Jacket, on portion of piping.

You're sure to lower your fuel consumption, increase efficiency when you specify K&M "Featherweight" 85% Magnesia Insulation. You have more than just our word for it . . . actual performance under a wide variety of service conditions has *proved* "Featherweight" to be the most efficient insulation of the moulded type, for temperatures up to 600°F.

In "Featherweight," you get the structural strength of asbestos fibre and the insulating perfection of magnesia . . . a light-weight, durable, fire-resistant combination that will give you optimum service over an indefinite period of time.

K&M Distributors, located strategically throughout the country, are expert applicators of K&M insulation materials. Let them help you gain substantial savings in your plant. Write for full details.

Nature made Asbestos . . .

Keasbey & Mattison has made it serve mankind since 1873

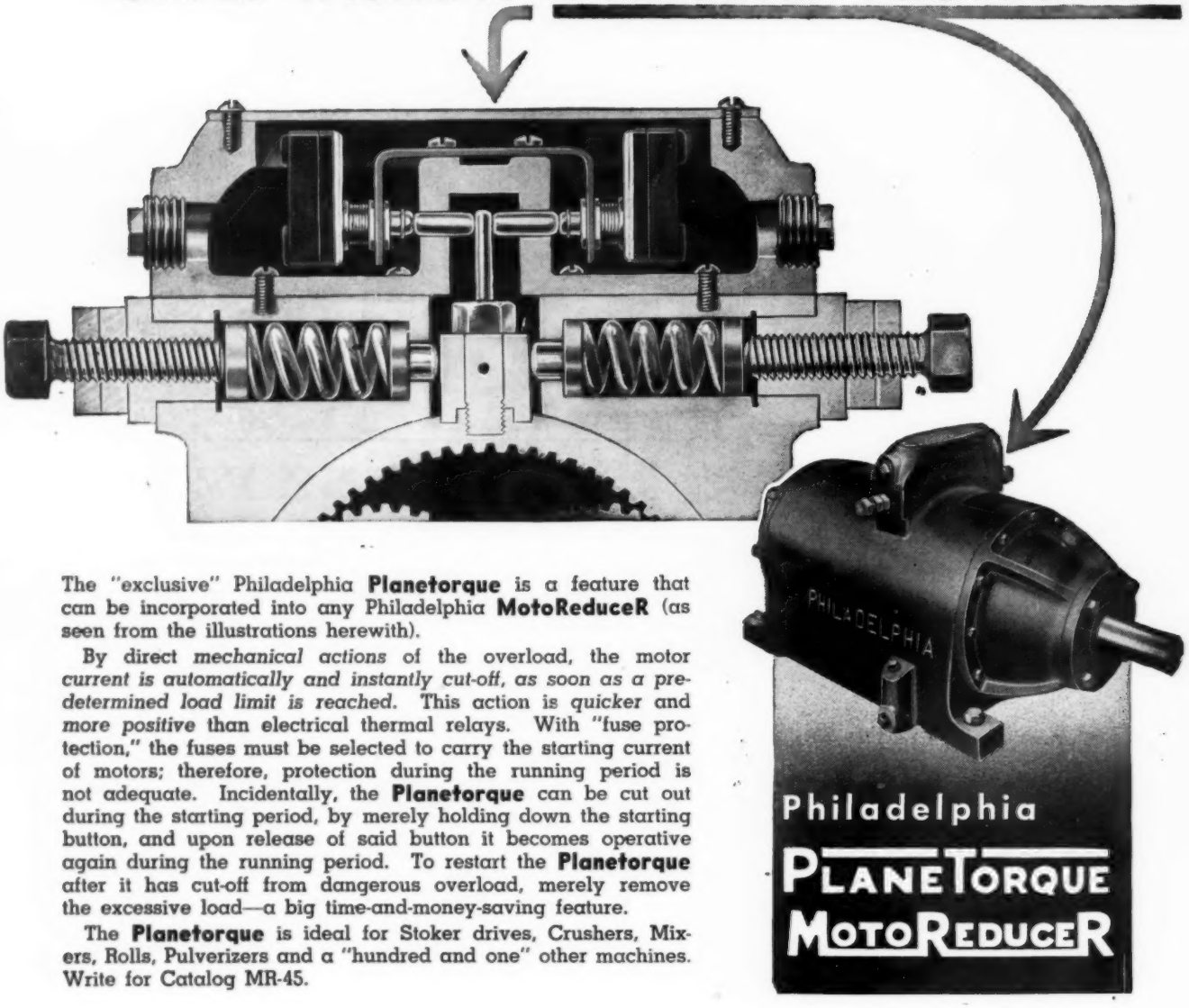
KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA
IN CANADA—ATLAS ASBESTOS CO., LTD. • MONTREAL, TORONTO, WINNIPEG and VANCOUVER

K&M best in asbestos

Reg. U. S. Pat. Off.

Automatically and Positively—

GIVES INSTANT OVERLOAD PROTECTION



The "exclusive" Philadelphia **Planetorque** is a feature that can be incorporated into any Philadelphia **MotoReduceR** (as seen from the illustrations herewith).

By direct *mechanical actions* of the overload, the motor *current is automatically and instantly cut-off, as soon as a predetermined load limit is reached.* This action is *quicker* and *more positive* than electrical thermal relays. With "fuse protection," the fuses must be selected to carry the starting current of motors; therefore, protection during the running period is not adequate. Incidentally, the **Planetorque** can be cut out during the starting period, by merely holding down the starting button, and upon release of said button it becomes operative again during the running period. To restart the **Planetorque** after it has cut-off from dangerous overload, merely remove the excessive load—a big time-and-money-saving feature.

The **Planetorque** is ideal for Stoker drives, Crushers, Mixers, Rolls, Pulverizers and a "hundred and one" other machines. Write for Catalog MR-45.

Philadelphia Gear manufactures Speed Reducers of the following types: Worm, Herringbone, Spiral-Bevel, Helical, Spur, and Horizontal and Vertical **MotoReduceRs**, etc. Also, Limitorque Motor Operated Valve Controls,—and of course, any type, size or quantity of Industrial Gears. Literature regarding each Philadelphia Product sent upon request on your business letterhead.

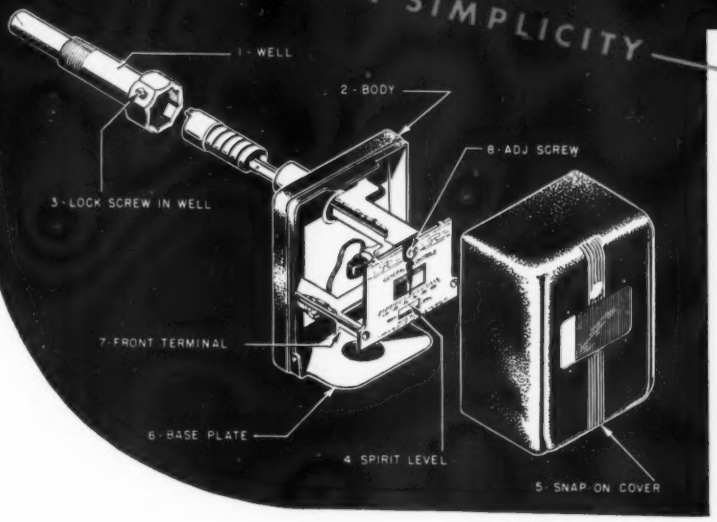
Philadelphia
GEAR WORKS INCORPORATED
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

NEW YORK • PITTSBURGH • CHICAGO . . . IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

8 FEATURES of the New L-578 series IMMERSION THERMOSTATS

ADVANCED DESIGN SIMPLICITY



- ★ **Accurate and positive in action.**
- ★ **Visual leveling indicator.**
- ★ **Complete selection of temperature ranges and switch combinations–** *Models to meet every requirement.*
- ★ **Fast reaction to liquid temperature change–** *Two-inch well provides large heat-exchange area for both direct and proximity contact with temperature-sensitive element.*
- ★ **Close temperature differential–** *Approximately 10° F. in most installation conditions.*
- ★ **Temperature setting easily changed–** *Just one external adjustment screw to turn.*
- ★ **Ample current capacity for use in all standing control systems–** *Up to 15 Amp. switch rating.*
- ★ **Mercury type switch–** *Dust-proof, tamper-proof, impervious to corrosive atmospheric conditions and "pitting" characteristics.*

For complete specifications request Bulletin SDL-32R-2.

GENERAL CONTROLS

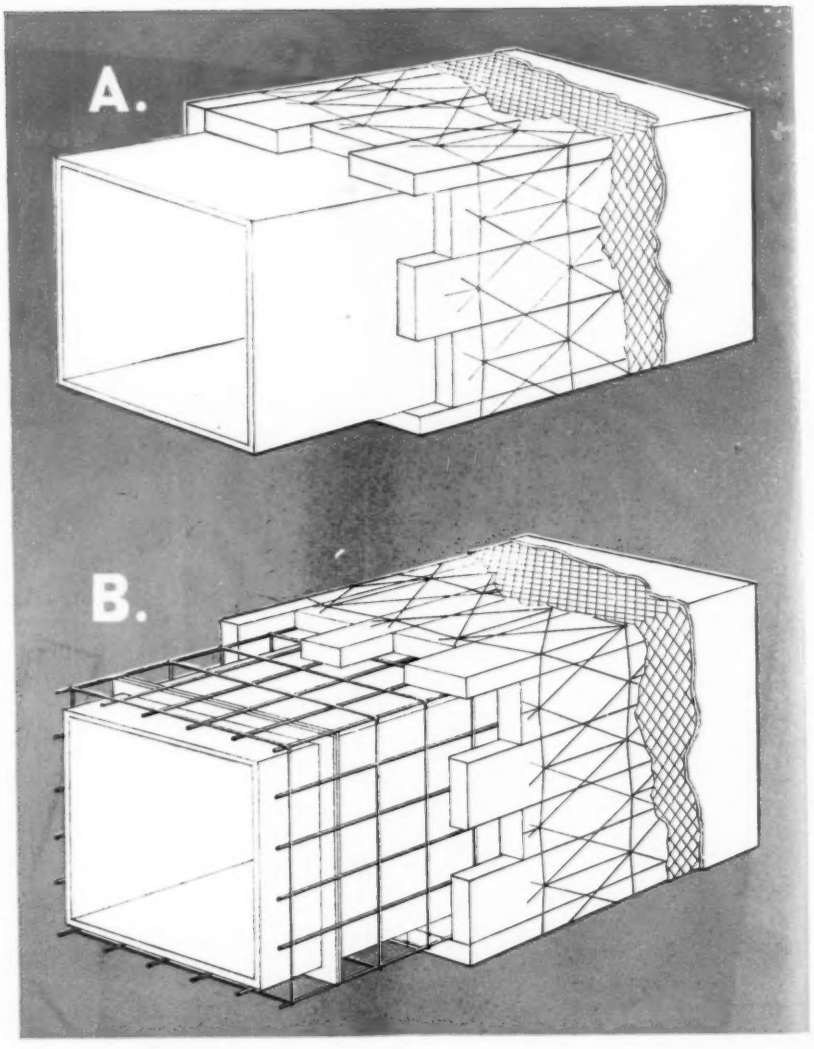
801 ALLEN AVENUE GLENDALE 1, CALIF.

Manufacturers of Automatic Pressure, Temperature & Flow Controls

FACTORY BRANCHES: BIRMINGHAM (3) • BOSTON (16) • CHICAGO (5) • DALLAS (2) DENVER (10) • DETROIT (8) • CLEVELAND (15) • HOUSTON (2) • KANSAS CITY (2) NEW YORK (17) • PHILADELPHIA (40) • PITTSBURGH (22) • SAN FRANCISCO (7) • SEATTLE (1)

DISTRIBUTORS IN PRINCIPAL CITIES

How would YOU insulate this breeching?



Here's the problem:

A metal breeching carries gases of combustion at temperatures from 500° to 575° F. from boiler to economizer. Which method of insulating the breeching will be most satisfactory?

A. 3" 85% Magnesia block applied directly to duct?

B. 3" 85% Magnesia block applied over air space?

Here's what the Armstrong engineer recommended

The first method costs less than the second—but it isn't best for this particular job.

Direct application of insulation is entirely satisfactory on hot air ducts and other applications where more moderate temperatures are involved. But in the case of this breeching, temperatures as high as 575° F. often occurred. With insulations applied direct, deterioration of the metal as well as the Magnesia might result.

The breeching can be protected by an air space between the metal and the insulation. Although the original job will cost slightly more, it will be less expensive than early replacement.

The air space can be provided either by welding pencil rods to the stiffener flanges (as shown here) or by applying V-ribbed metal lath, with 1" ribs on 18" centers which keep it away from the duct. After the magnesia is applied, it is wired in place, covered with hexagonal mesh wire and two coats of asbestos cement.

Safety factors like this cost money, but they offer economy in the long run, and good engineers are careful to include them in all their calculations. In this case, the low-cost job might last. But the chance that rises in temperature would cause it to go bad is too great to take. The Armstrong engineer is trained to size up all possibilities and recommend methods which cut risks to the minimum.

When you work with Armstrong's Contract Service, the insulation specification is written for your special requirements—it's filled with exactly the materials your job calls for—and it's installed by skilled craftsmen. The entire Armstrong organization takes responsibility.

FREE INSULATION CHART

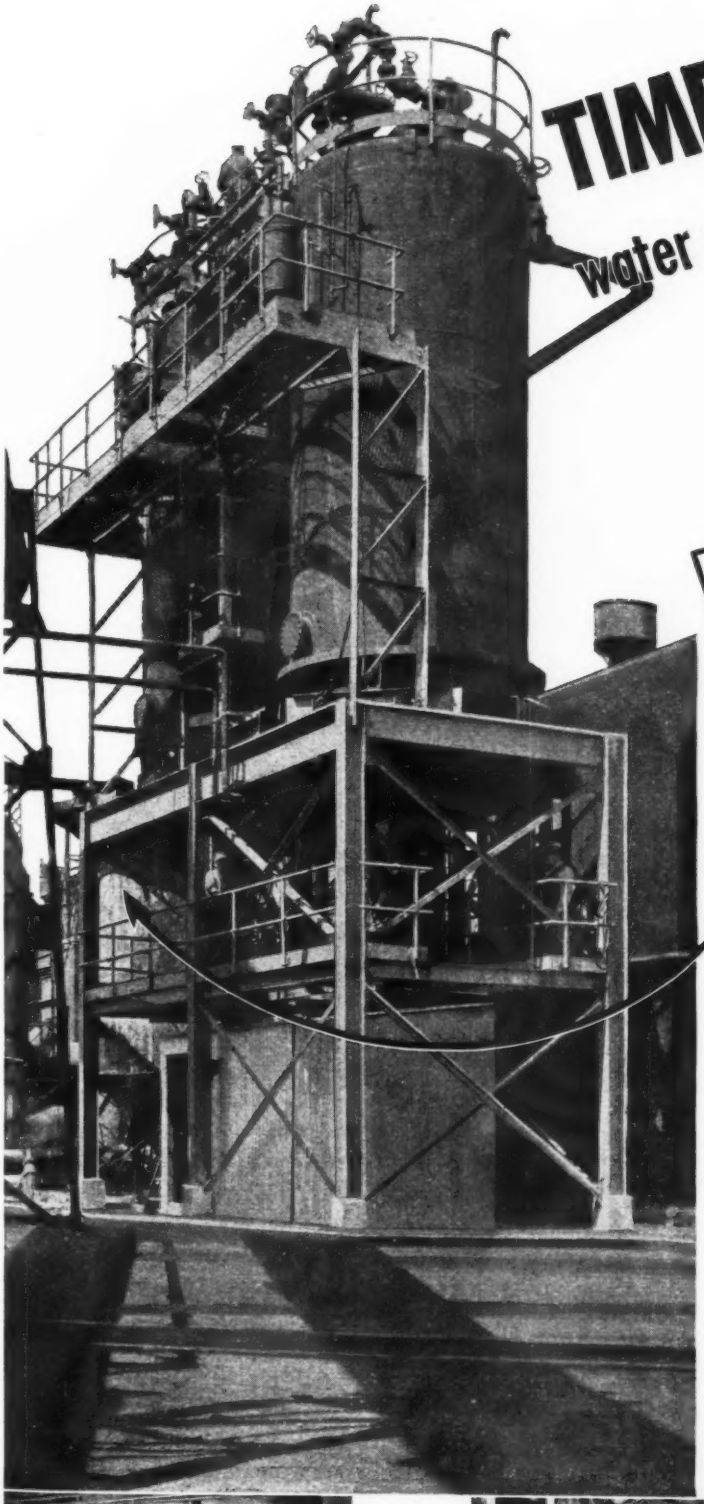
This chart lists types and thicknesses of insulation for temperatures from 300 below zero to 2800° F. Write today to Armstrong Cork Co., Industrial Insulation Department, 7010 Maple Ave., Lancaster, Pennsylvania.

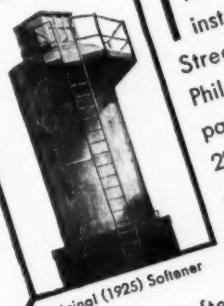
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero to 2800° Fahrenheit

TIME (and improvement in water softening) MARCHES ON!

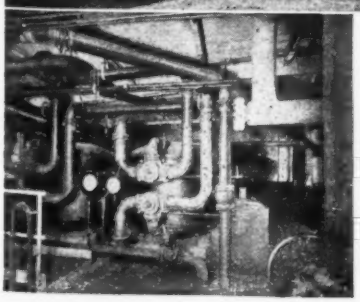




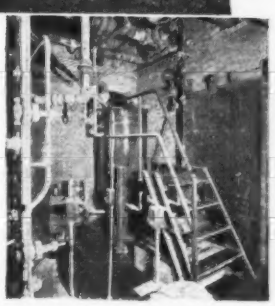
Original (1925) Softener

IN 1925, a Cochrane Hot Process Softener was installed in the Tilghman Street Gas Plant of the Philadelphia Electric Company at Chester, Pa. Now, 22 years later, this faithful old piece of equipment is being replaced by a new Cochrane Double Unit Hot Process Softener of 20,000 GPH capacity (10,000 GPH per unit). The double unit permits great flexibility of operation as one or both units may be used as desired. The needs of the plant have outgrown the capacity of the first unit which is largely the reason for the change, but the improvements in the process and the apparatus since 1925 are interesting in comparison with the old veteran. Welded construction replaces riveted, chemical proportioning and feeding are improved, automatic controls are featured and softening is accomplished with a speed and accuracy of result undreamed of in 1925.

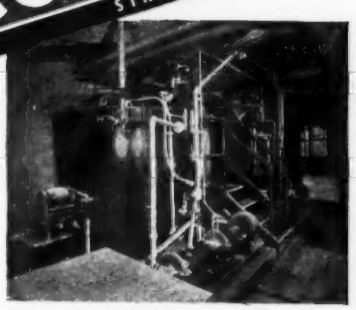
COCHRANE
SINCE 1863



(Left) Two vertical pressure filters replacing existing conical filters shown in background



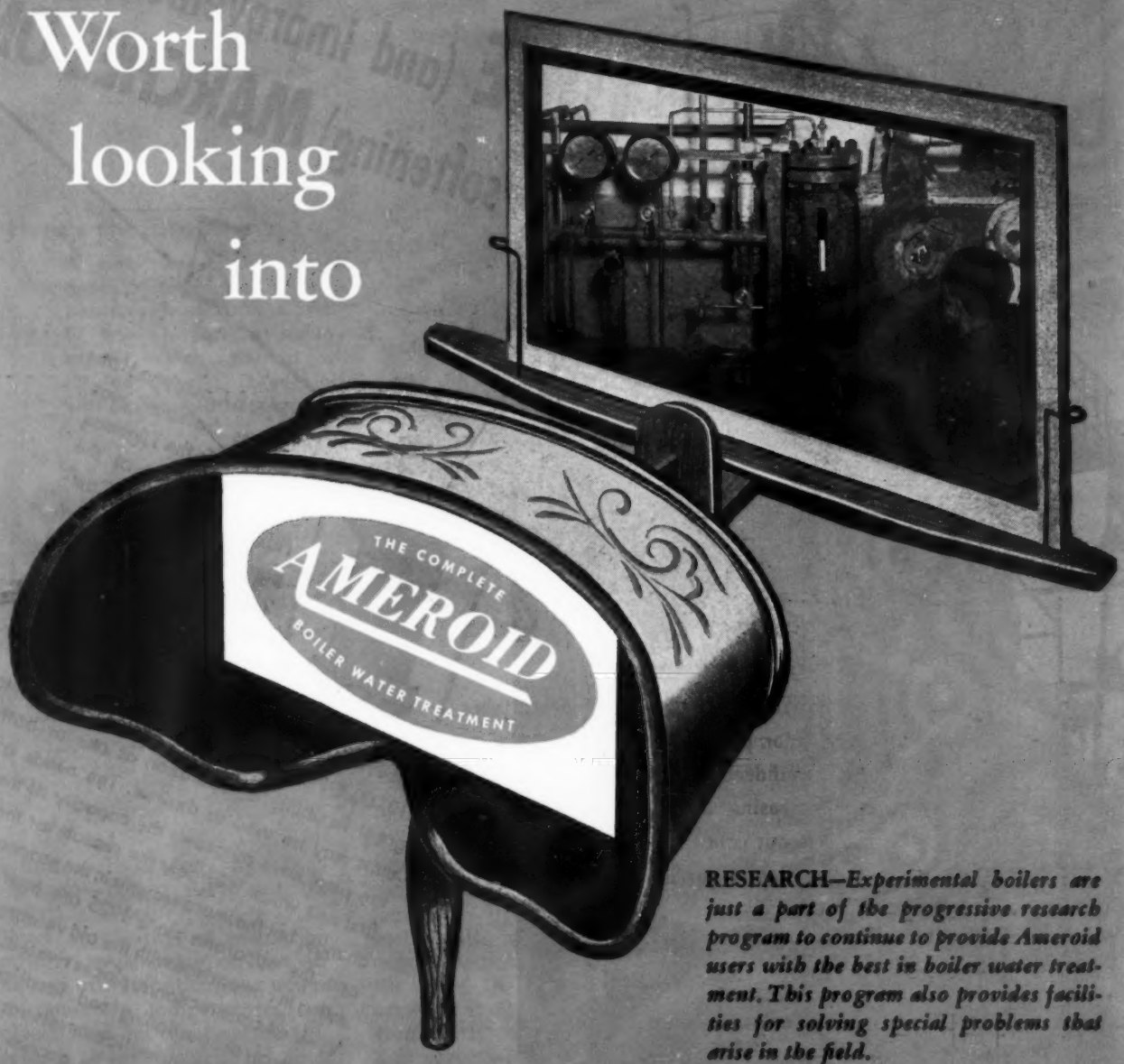
(Left) phosphate tank with motor driven agitator for mixing supplemental phosphate feed



(Left) Lime soda proportioners and mixing tanks

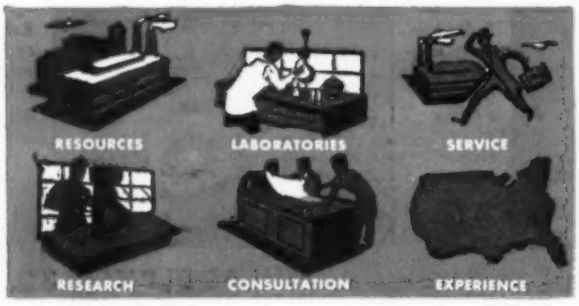
COCHRANE CORPORATION · 3106 N. 17th Street · PHILADELPHIA 32, PA.

Worth looking into



RESEARCH—*Experimental boilers are just a part of the progressive research program to continue to provide Ameroid users with the best in boiler water treatment. This program also provides facilities for solving special problems that arise in the field.*

When you look into the AMEROID system you'll find it backed by all the factors necessary for a completely successful boiler water treatment . . . a national service organization of trained chemists and engineers; modern analytical laboratories; controlled manufacturing facilities; a progressive research program; and the "know how" that comes only from wide experience. An AMEROID representative will be happy to discuss boiler water conditioning with you at your convenience.



E. F. DREW & CO., INC.
15 EAST 26th STREET, NEW YORK 10, N. Y.
COMPLETE AMEROID SERVICE is available in key cities of the United States, Canada, Mexico, Brazil and Puerto Rico.

WM. W. NUGENT & CO., INC.

WILLIAM W. NUGENT

FOUNDER 1861-1938

1897 *50th Anniversary* 1947

The Wm. W. Nugent & Co., Inc., takes this opportunity, on the occasion of its Fiftieth Anniversary, to express its appreciation for the confidence and loyalty toward Nugent products expressed by an ever increasing acceptance throughout industry. As in the past half-century, it is our continued aim to insure that Nugent products embody only highest quality design, materials and workmanship.

Boliss D. Nugent

President

Manufacturers of OIL FILTERS . . . OILING AND FILTERING SYSTEMS
TELESCOPIC OILERS . . . OILING DEVICES . . . SIGHT FEED VALVES
FLOW INDICATORS . . . COMPRESSION UNION FITTINGS . . . OIL PUMPS
OIL TANKS . . . AND ALLIED EQUIPMENT

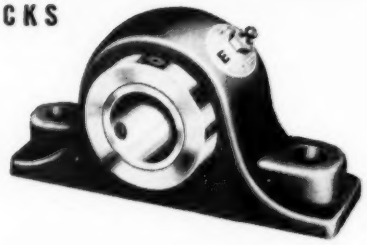
1897 Fiftieth NUGENT TRADE MARK Anniversary 1947

NUGENT TRADE MARK

Wm. W. Nugent & Co., Inc., Mfrs.
402 North Hermitage Avenue
CHICAGO 22, ILLINOIS

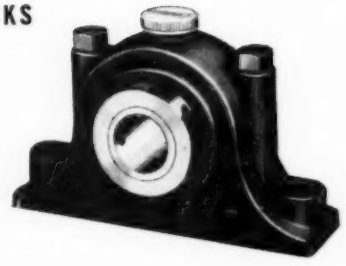
NUGENT TRADE MARK

DODGE-TIMKEN TYPE "E" PILLOW BLOCKS



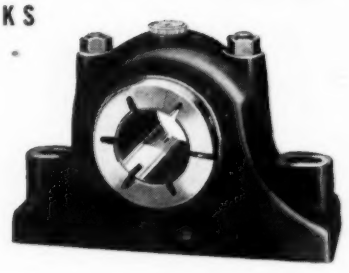
Superior performance at moderate cost. High speed capacity. Sizes 1-3/16" to 4".

DODGE-TIMKEN DOUBLE INTER-LOCK PILLOW BLOCKS



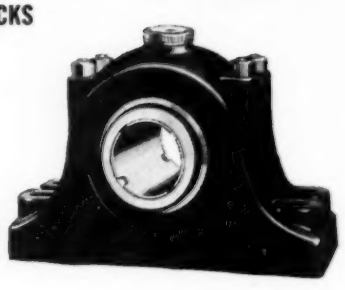
For general service. Normal radial, thrust and shock loads. 1-7/16" to 4-15/16".

DODGE-TIMKEN TYPE "C" PILLOW BLOCKS



Triple sealed against fine abrasive dust. Shaft sizes are 1-3/16" to 4-15/16".

DODGE-TIMKEN SPECIAL DUTY BALL AND SOCKET PILLOW BLOCKS



Rugged, heavy duty, high speeds. Made in shaft sizes from 1-7/16" to 8".

For Unquestioned Quality—

DODGE-TIMKEN

On anti-friction bearings, these two names are assurance of dependability and performance which enable you to cut costs and increase production. Dodge mounts, seals and houses the precision bearing assemblies and delivers them fully assembled, adjusted and lubricated—ready to lock on the shaft. Parts required for mounting these bearings are manufactured complete in the Dodge factory—from foundry through many precision operations on the latest machine tool equipment. The bearings pictured are from the famous Dodge 30,000 hour line, covering a broad range of industrial bearing requirements, promptly available from distributors' stocks.

DODGE MANUFACTURING CORPORATION • MISHAWAKA, INDIANA

CALL THE TRANSMISSIONEER

your local Dodge distributor, for news of latest developments in power transmission equipment. Look for his name in your classified telephone book under "Power Transmission Equipment."

DODGE

of Mishawaka, Ind.

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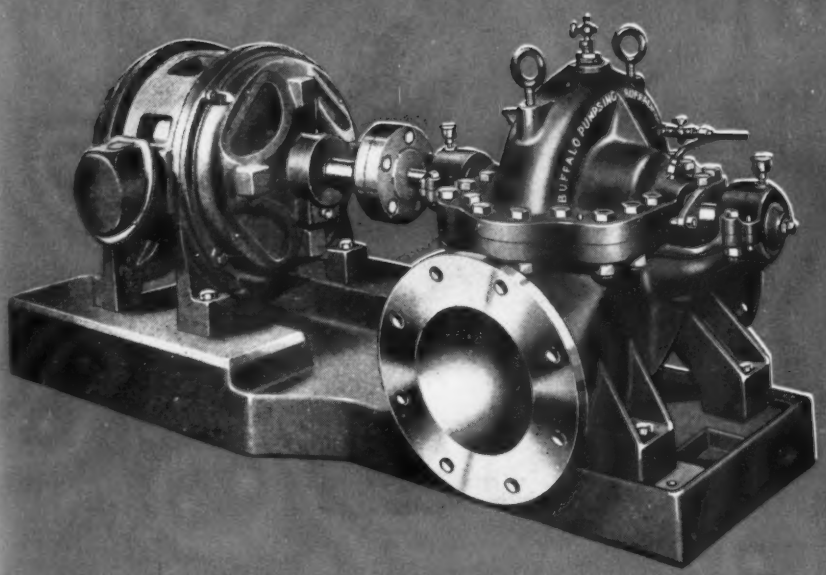
NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS

Durable, Dependable Double Suction Pumps



Where you need water pumping service in any capacities from 10 to 10,000 U.S. Gallons Per Minute, be sure to get the facts on "Buffalo" Double Suction Single Stage Centrifugal Pumps!

You'll find the "Buffalo" Double Suction Impeller your assurance of perfect hydraulic balance and peak efficiency.

You'll find the horizontally divided casing allows quick impeller inspection without disturbing piping.

You'll find them designed for direct motor, turbine or gasoline engine drive — pulley drive — clockwise or counter-clockwise rotation, as desired.

You'll find "Buffalo" Double Suction Pumps giving long, satisfactory service at low cost in every branch of industry.

Write now for your copy of Bulletin 955-L, which gives all engineering data.

BUFFALO PUMPS, INC.

488 BROADWAY — BUFFALO, N. Y.
Canada Pumps Ltd., — Kitchener, Ont.

"Buffalo"

SINGLE STAGE DOUBLE SUCTION PUMPS

Simple, positive, modern

BECAUSE IT'S

Electrical

HAYS AUTOMATIC COMBUSTION CONTROL

Just as more and more industrial equipment items are being electrically driven—stokers, pulverizers, fans, blowers and the like—so is it practical good sense to operate an automatic combustion control system electrically. Thus are utilized the advantages of simplicity, speed and dependability inherent in this fool-proof modern method.

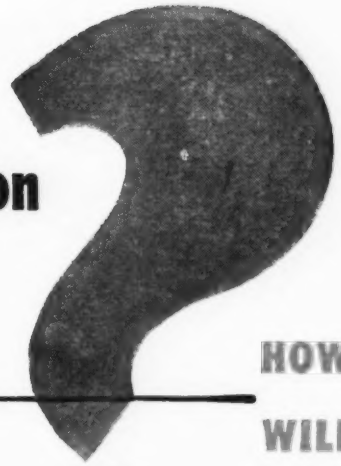
Hays Centralized Control is wholly electrical—with enclosed mercury switches for the sensitive contacts; no moisture, no dust, no other foreign material to cause sticking, chattering and excessive wear. Installation is easy, maintenance is simplified. Adjustments are made direct—not dependent on air pressures, oil pressures and numerous valve mechanisms characteristic of non-electrical designs.

For full details concerning this Method of Tomorrow, send for Bulletin 46-605—contains schematic drawings of 14 typical installations. Write for it.

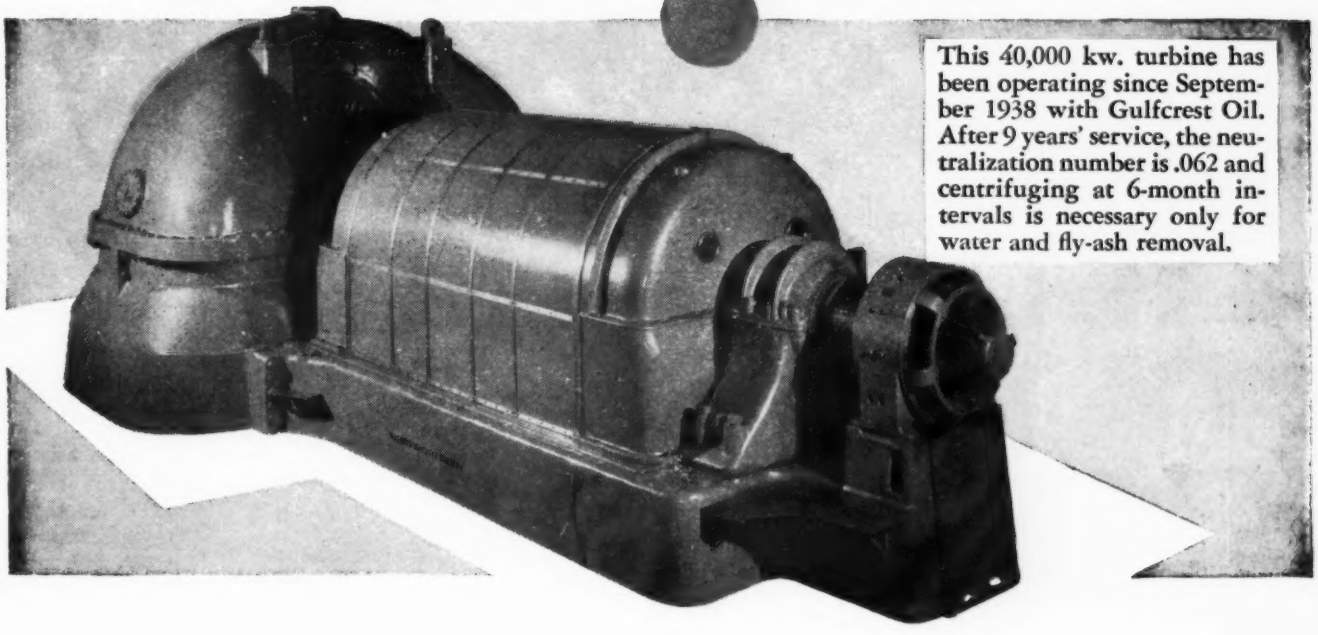
HAYS *Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA

A vital consideration in turbine oil selection



HOW LONG WILL IT LAST?



This 40,000 kw. turbine has been operating since September 1938 with Gulfcrest Oil. After 9 years' service, the neutralization number is .062 and centrifuging at 6-month intervals is necessary only for water and fly-ash removal.

GULFCREST OIL WCR

lasts indefinitely!

HOW long will it prevent formation of harmful sludge? How long will it maintain a low, safe neutralization number? These are important questions in turbine oil selection.

When you select Gulfcrest Oil WCR, you get an oil that lasts indefinitely! The important reason: After conventional refining, Gulfcrest Oil is superrefined by the Alchlor Process.

More than 15 per cent of the oil is discarded by the Alchlor Process—this 15 per cent contains the hydrocarbons most likely to oxidize and form sludge, emulsifiers, and harmful acids.

That's why Gulfcrest is incomparably pure—why it gives outstanding performance, and lasts indefinitely. Send the coupon at right for booklet which gives you the complete facts on this superior turbine oil.

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Gulf Oil Corporation · Gulf Refining Company

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Gulf Oil Corporation · Gulf Refining Company P
3800 Gulf Building, Pittsburgh 30, Pa.

Please send me, without obligation, a copy of your booklet "Gulfcrest Oil for Steam Turbine Lubrication."

Name.....

Company.....

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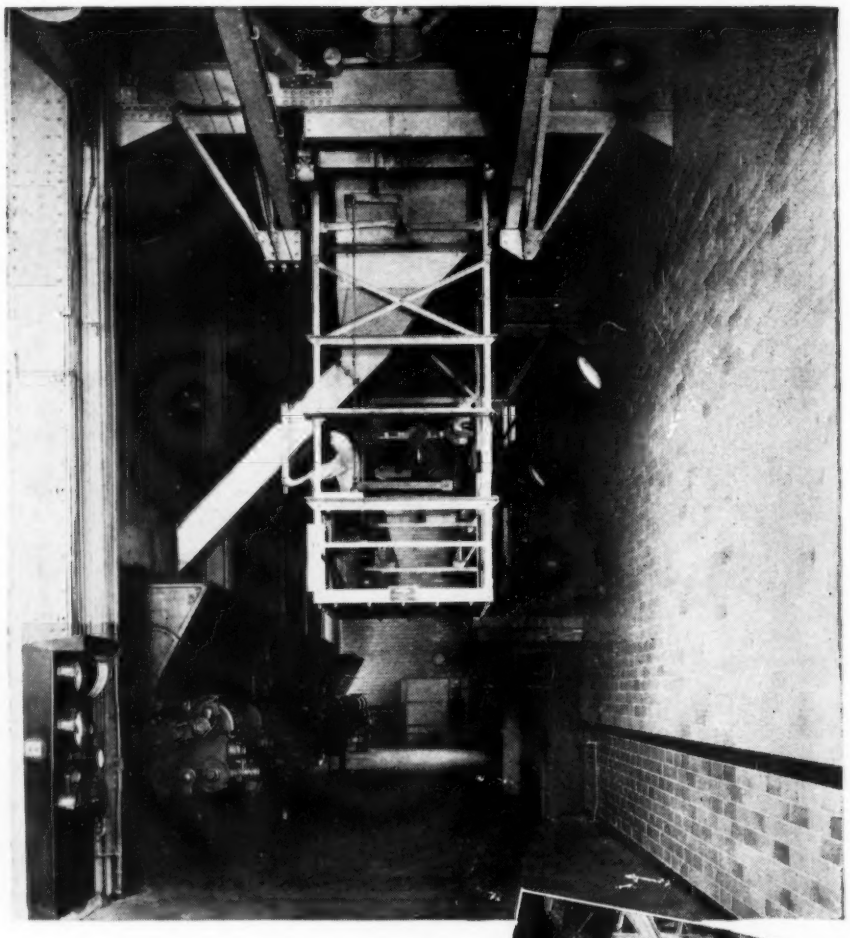
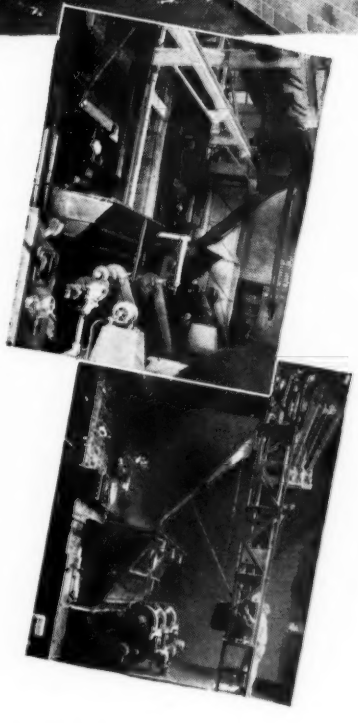
Address.....

WEIGH LARRIES



from 1/2 ton capacity up



BARTLETT-SNOW Weigh Larries eliminate segregation. They produce an even dispersion of lumps and fines in the stoker hopper, resulting in ideal draft and burning conditions, —and cost less than fixed chutes each fitted with cut-off gates, scales, etc. when four or more stokers are being served from an overhead suspension bunker. Weigh Larries permit the use of a cylindrical coal bunker located at the end of the building, simplifying building construction, assuring ample light and ventilation, and easy access to the boilers for maintenance and repairs. Furnished in hand propelled and motor-driven, floor or cage operated types. Send for Bulletin No. 83. It gives full details.

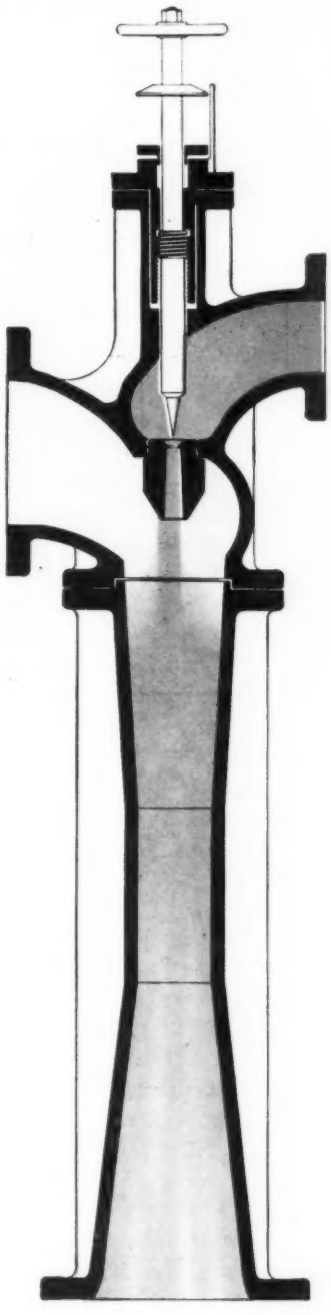
THE C. O. BARTLETT & SNOW CO.

6205 Harvard Avenue, Cleveland 5, Ohio

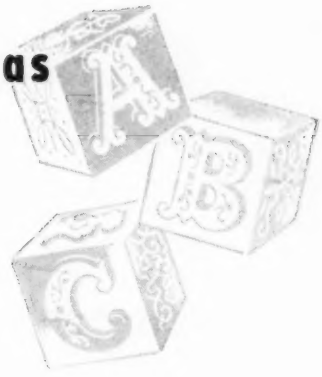
Engineering and Sales Representatives in the Principal Cities

COAL HANDLING FOR CENTRAL STATIONS AND INDUSTRIAL BOILER PLANTS

an ƒ "reason why"



as simple as



With an ƒ Jet Compressor . . .

Circulation of steam for better heating . . .
Boosting of low pressure steam . . .
And mixing of gases in desired proportion . . .
Become as simple as ABC.

The ƒ Jet Compressor . . .

Utilizes a jet of high pressure gas . . .
To entrain a low pressure gas . . .
Mix the two . . .
And discharge them . . .
At an intermediate pressure.

The ƒ Jet Compressor is of simple construction . . .

With no rapidly revolving parts . . .
To get out of order . . .
Adjust or repair.
It reduces wear to a minimum . . .
Requires little maintenance . . .
Operates economically . . .
With maximum efficiency.

Write for ƒ Bulletin 4-F . . .

It contains detailed information.

SCHUTTE and KOERTING Company

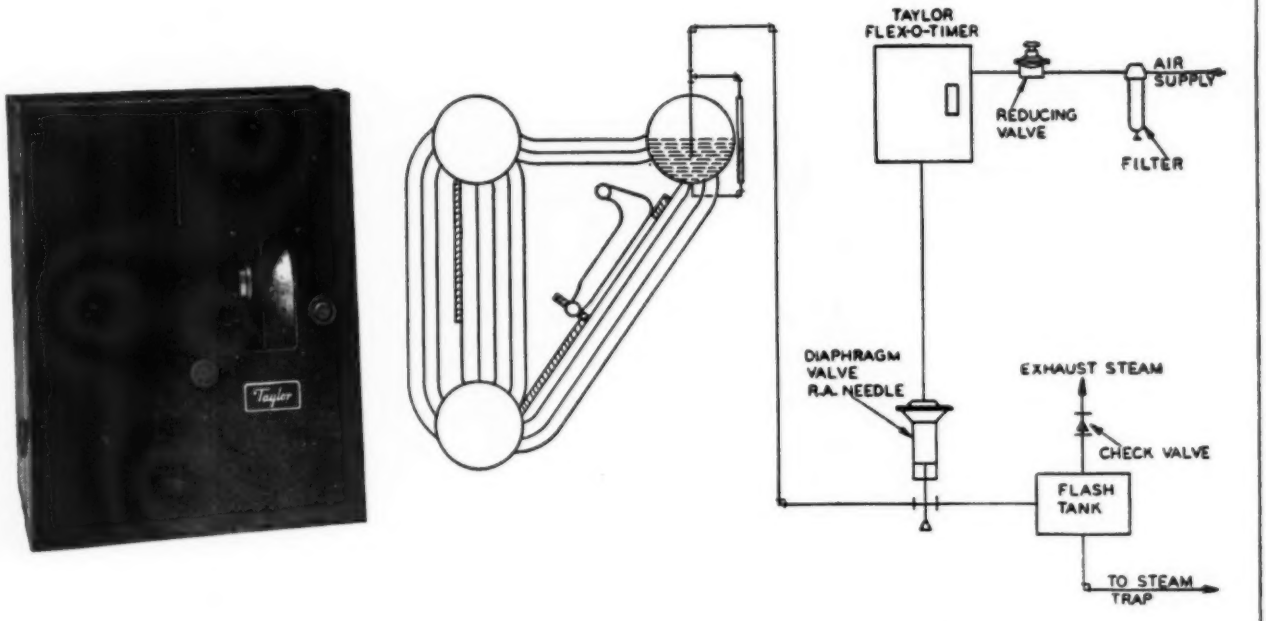
Manufacturing Engineers

1150 THOMPSON ST., PHILADELPHIA 22, PA.

JET APPARATUS • CONDENSERS AND VACUUM PUMPS • HEAT TRANSFER EQUIPMENT
VALVES • ROTAMETERS AND FLOW INDICATORS • GEAR PUMPS • STRAINERS
OIL BURNING EQUIPMENT • SPRAY NOZZLES AND ATOMIZERS • RADIAFIN TUBES

Schutte and Koerting have *always* quoted "Firm Prices" — a principle in good business, for all business.

Want to improve boiler blow-down practice?



Taylor Automatic Blow-down Control System

HERE'S one good way—an *automatic* control system that completely does away with continuous blow-down on your boilers! No more costly valve replacement or plugged blow-down lines! Diagram shows how a Taylor Flex-O-Timer operates a diaphragm valve on the blow-down line. Where several boilers are involved, the Flex-O-Timer can be fitted to operate more than one blow-down valve.

There's absolutely no throttling action of the valve. The Flex-O-Timer automatically opens it fully then shuts it tight at time intervals set by your Chief Engineer or operator according to concentration and alkalinity of the water. This adds up to five valuable ways Taylor Automatic Blow-down Control can help you:

1. Saves steam.
2. Minimizes valve seat replacement.
3. Eliminates waste of boiler feed water.
4. Holds water concentration at correct value.
5. Maintains alkalinity at the desired point.

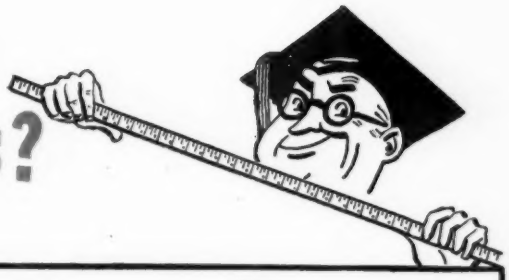
Write for Bulletin 98149 today! It gives full details on this and other accurate, dependable Taylor control systems for power plants. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Ontario.

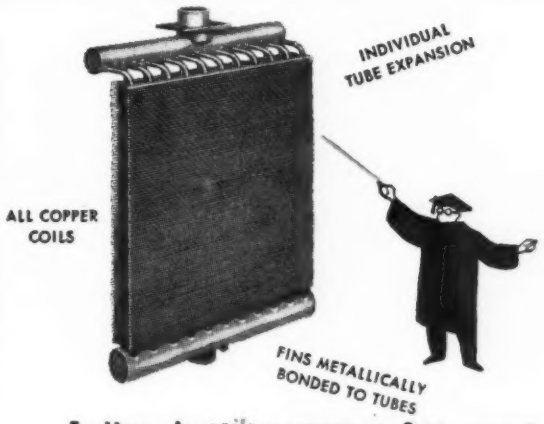
• • •

Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.

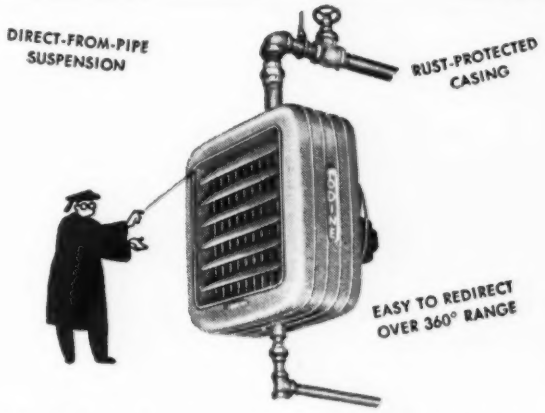
Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

Want a Yardstick for Selecting Unit Heaters?





1. How do coils measure up? No screwed or expanded joints. No gaskets or bolts. Modine's controlled brazing process eliminates weak spots, provides one-piece integrated construction that means greater strength, longer life, better performance.



2. What about suspension? Modine users report installation savings up to $10 per unit. Patented center supply and return connections mean unit can be suspended directly from supply line with complete safety. No expensive supports. No extra labor costs.

3. Is power up to par? A motor must meet rigid performance requirements before it can team up with a Modine unit heater. Only heavy-duty, totally enclosed, nationally known makes are chosen. Rubber mounted, noised-proofed for hush-hush service.

4. Why not get the answer? See how Modine Unit Heaters can meet your space-heating needs! Send coupon today for free Modine catalog jam-packed with diagrams, pictures, specifications, installation ideas, etc. Get this valuable addition to your technical library!

MEASURE the Job and Meet the Need!

When you buy Modine, you buy an extra dash of beauty — a host of features that make it *the* quality unit heater. Choose from three types with 47 basic capacities: 1) Horizontal Delivery Type for general applications. 2) Vertical Delivery Type for overhead use. 3) Power Throw Type for special high velocities. Look for Modine's representative in the "Where-to-Buy-it" section of your phone book, or send in coupon at right.

MODINE MANUFACTURING CO.
151 / Dekoven Street
Racine, Wisconsin

YES! I want all the facts about Modine's integrated Unit Heater Line. Please send me complete information.

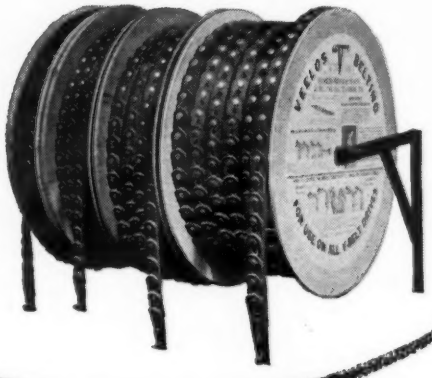
NAME.....

ADDRESS.....

CITY.....STATE.....

Modine UNIT HEATERS

Here's all you need to be sure of Every Size you need



WHATEVER length V-belt you may require, it's always on hand when you use Veelos, the link V-belt on reels. From just four reels you can replace up to 316 standard sizes. Need less? Any length belt can be uncoupled from a single reel, quickly coupled endless on the drive.

Veelos on reels banishes costly belt inventories. Stocking matched sets for each drive is eliminated. You *profitably* use every bit you buy. There is no belt waste. Time-consuming paper work is greatly reduced. Reels of Veelos hold 100 feet . . . save stockroom space. Veelos is available in all standard widths, fits all standard grooves.

Sales engineers are located in all principal cities; over 300 distributors throughout the country.

MANHEIM MANUFACTURING & BELTING COMPANY
MANHEIM, PENNSYLVANIA

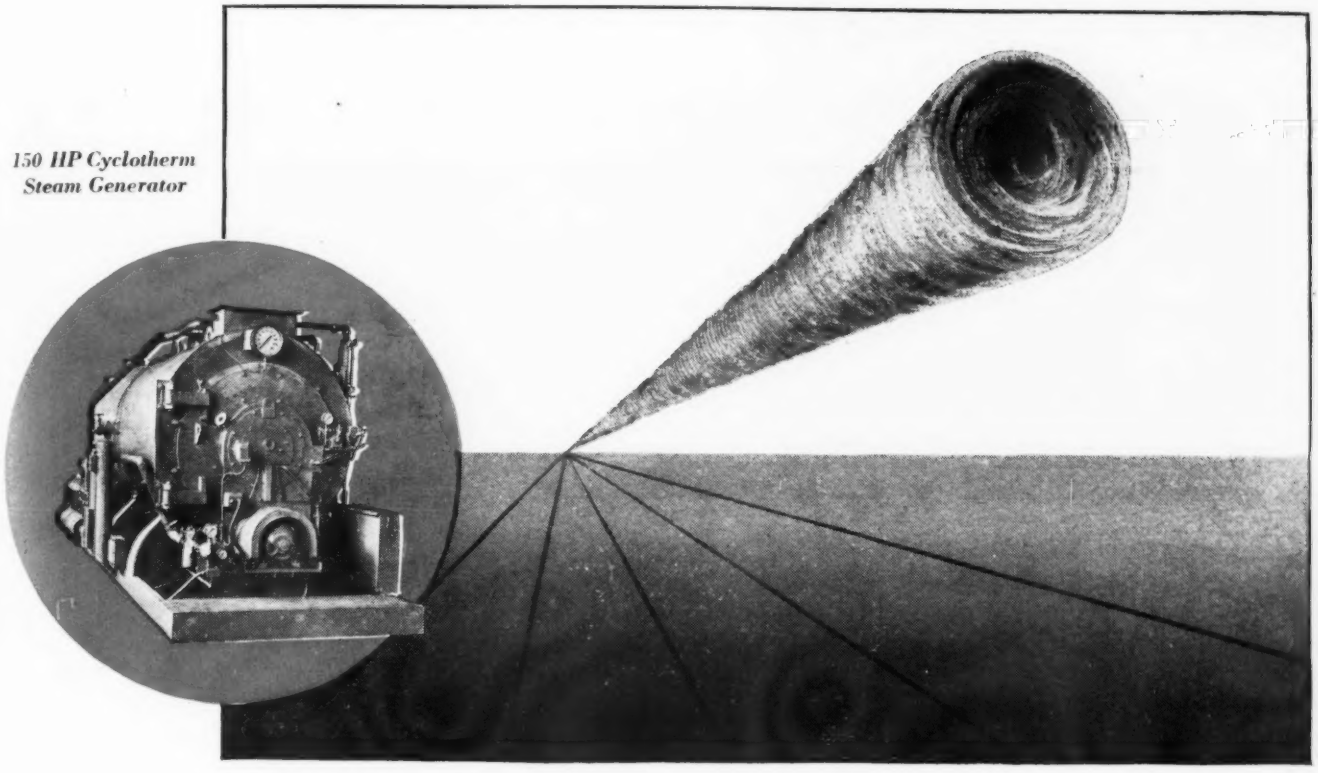
VEELOS
THE LINK
V-BELT

Adjustable to any Length
Adaptable to any Drive

New Veelos Catalog shows you how to get the *right* length V-belt right off the reel. You'll see it uncoupled, made endless, installed (pages 8 and 9). All 14 Veelos advantages are described in detail. Complete engineering data is provided. Also, a dozen pages—packed with photographs—show Veelos at work in a wide variety of industries. *Your free copy sent on request.*

Tested, Proved and Adopted by American Industry

KNOWN AS VEELINK OUTSIDE THE UNITED STATES



150 HP Cyclotherm Steam Generator

EFFICIENCY that solves fuel shortage problems

Cyclotherm patents control a combustion principle that burns atomized fuel *completely* in a rapidly revolving cyclonic flame in the first pass of a two pass boiler. This highly radiant cyclone of flame advances slowly through the length of the furnace tube so that the heat is radiated intensely and uniformly.

Cyclotherm will burn any gaseous or liquid fuel and release the maximum amount of heat for efficient and economical steam generation. By converting fuel into the maximum amoun' of steam, a Cyclotherm solves all but the most stringent fuel shortages.

Cyclotherm Steam Generators of 80 to 300 HP are equipped with an automatic modulating steam pressure control system which regulates the volume of the flame in response to steam demand. Firing rates are modulated from 30% to 100% of rated capacity. Units of 10 to 60 HP utilize the "on-and-off" method of operation which is immediately responsive to thermostat or pressure control and is more economical on small boilers. Both methods of firing are guaranteed 80% efficient.

Cyclotherm boilers are manufactured to burn oil, gas (natural or manufactured) or in combination in sizes from 10 to 300 HP with operating pressures from 15 to 200 psi. They have a steam output range from 345 lbs. per hour (from feed water at 212°F) to 10,390 lbs. per hour. For greater steam requirements, a battery of two or more Cyclotherms is recommended.

Today Cyclotherm can assure you prompt factory delivery.

For further information on saving more fuel, write for our specially prepared booklet 402Z

POWER

PROCESSING

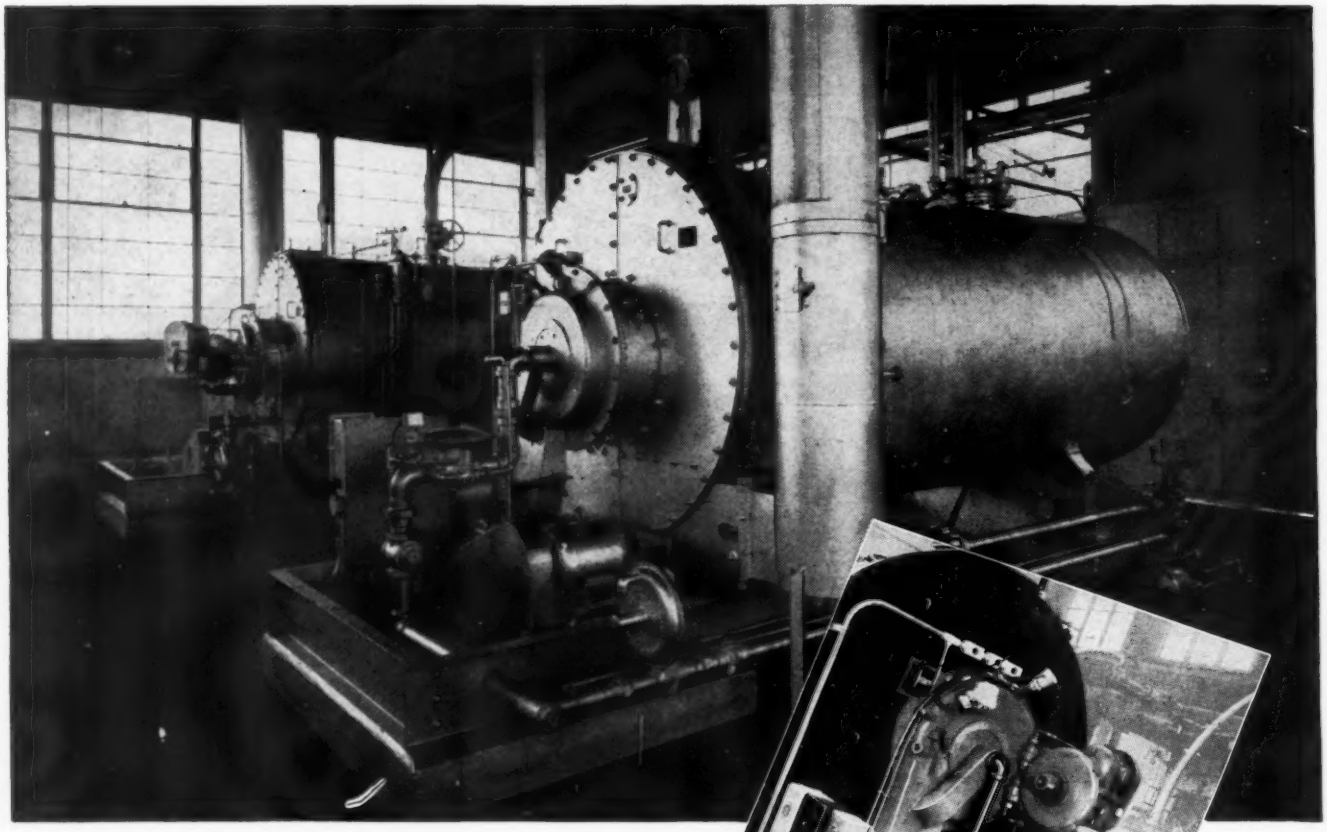
HEATING

CYCLOTHERM STEAM GENERATORS

CYCLOTHERM CORPORATION, 90 BROAD STREET, NEW YORK 4, N. Y.

BURN GAS — BURN OIL — BURN EITHER

in Steam Generators Expressly Adapted to the Fuel in your Area

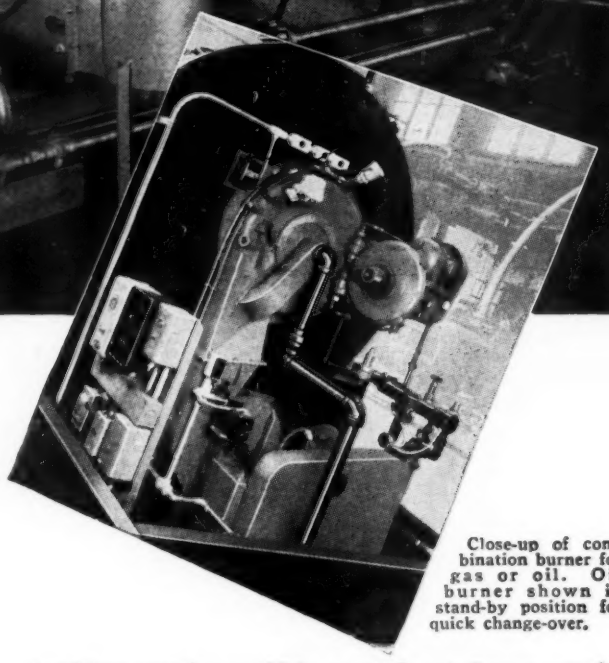


Installation shows two models of 200 HP. Cleaver-Brooks Steam Generators. Foreground model — gas-fired; model shown in rear equipped with a combination burner to burn either gas or oil.

Get Guaranteed 80% Efficiency with either Fuel with a Cleaver-Brooks Steam Generator

INSTALL a steam generator equipped to burn the available fuel in your area—either oil or gas. Cleaver-Brooks offers all three: (1) Oil-fired models, (2) gas-fired models, and (3) models equipped with a combination burner which permits alternate use of gas or oil, providing for a quick change-over from one fuel to the other. Equally important—you get Cleaver-Brooks' guarantee of at least 80% efficiency from full load down to 30% of rating—with either gas or oil as fuel.

And that's not all—more advantages are gained using a Cleaver-Brooks "packaged" steam generator. They give you clean, smokeless operation—eliminate fuel-ash handling—require no high or costly stacks—no special foundations—fit under low headroom—flexible operation to meet fluctuating loads. Fully meet all codes.



Close-up of combination burner for gas or oil. Oil burner shown in stand-by position for quick change-over.

Investigate Cleaver-Brooks Steam Generators—there's a size to fit your needs—15 to 200 p.s.i., 15 to 500 HP.

CLEAVER-BROOKS COMPANY

332 E. KEEFE AVE., MILWAUKEE 12, WISCONSIN

WRITE on your business letterhead for free Steam Cost-Calculator — a ready-reference slide rule showing comparative steam cost when using oil, gas or coal as fuel.

Cleaver-Brooks

"Packaged" STEAM GENERATORS

HAVE SERVED INDUSTRY FOR MORE THAN FIFTEEN YEARS

HOW TO KNOCK TOUGH PROBLEMS FOR A LOOP

Another top performance by a BWH product

When heavy, highly abrasive magnetite ore had to be whisked from hopper to hopper for refining, a leading foundry found BWH Bull Dog Ore Handling Hose the answer to a lot of tough problems.

This hose, while highly flexible, is also amazingly durable. Multiple plies of heavy duck are wound over a tough one-inch-thick rubber lining. Beneath the two outer plies is a high tensile spiral wire embedded in high-quality rubber.

Spaced to give the hose maximum flexibility, this wire also adds strength and prevents kinking.

Finally, a high-grade, age-resistant rugged rubber cover encloses both tube and carcass. Fittings are of the outside sleeve type, which means no metal has a chance to come in contact with the abrasive ore, and service of the hose is therefore greatly prolonged.

With this BWH Ore Handling Hose on the job, ore and waste sand were efficiently separated in a low-cost, trouble-free operation.

Bull Dog Ore Handling Hose is just one of the many quality products manufactured by BWH. Whenever you require this or other types of industrial rubber goods, look to BWH for dependable ruggedness . . . and to BWH distributors for dependable service.

HAVE YOU A PROBLEM WHERE STAMINA COUNTS?

Bring us your toughest problems . . . we're specialists in solving them. Consult your nearest BWH distributor, or write direct.

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

Distributors in all principal cities

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"For commercial or industrial installation, I recommend Todd Burners"

...for minimum fuel consumption,
TODD BURNERS

THE costs of operating mechanical equipment are being examined today with the strictest possible scrutiny, for they offer the most fruitful opportunity for *reducing* overall operating expense in both commercial buildings and factories. In the field of heat and power, Todd Oil Burners provide real possibilities of pulling down both day by day charges, and long range maintenance expense, wherever obsolete oil burning equipment is used. In many such cases fuel consumption, for instance, has been cut as much, or more, than 10%. *While for a new building,* Todd Burners offer the opportunity to start operations with top efficiency.

Consult Todd engineers on your heat and power requirements!

COMBUSTION EQUIPMENT DIVISION
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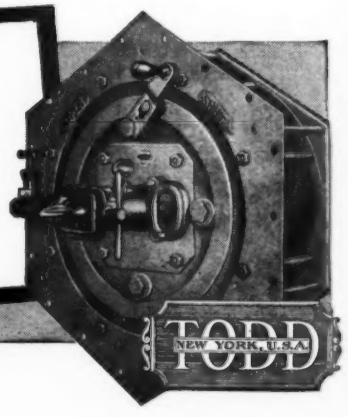
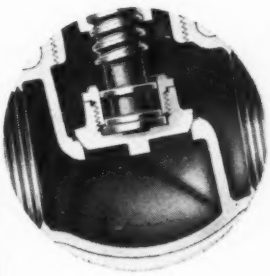
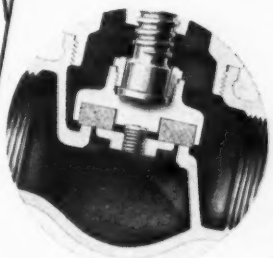


Guide for Selecting KENNEDY BRONZE GLOBE VALVES



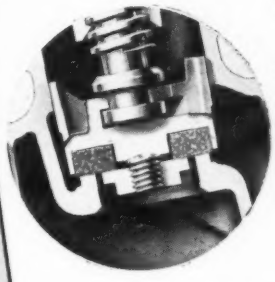
BRONZE DISC
Screwed Bonnet

This valve is designed for standard pressure, general service. Like all Kennedy Bronze Globe and Angle Valves this type can be repacked under pressure when wide open.



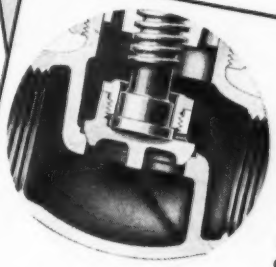
RENEWABLE COMPOSITION DISC
Screwed Bonnet

The discs in these standard-pressure valves are built to standard dimensions . . . those carried in stock by all supply houses. Kennedy offers various compositions . . . each selected to meet specific operating conditions. The exceptionally high raised seat assures longer disc life.



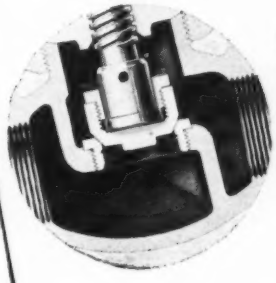
RENEWABLE COMPOSITION DISC
Union Bonnet

The convenient Slip-on Disc Holder speeds up renewing the disc on these 150 lb. Kennedy valves. This holder is accurately guided in the body by four guided prongs which maintain alignment and prevent binding.



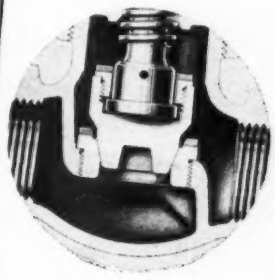
REGRINDING DISC
Union Bonnet

The discs of these 125 lb. and 200 lb. valves are designed to permit repeated regrinding . . . without removing the valve from the line. The body, bonnet, union bonnet ring and disc are made of the same metal as used for 300 lb. Kennedy valves.



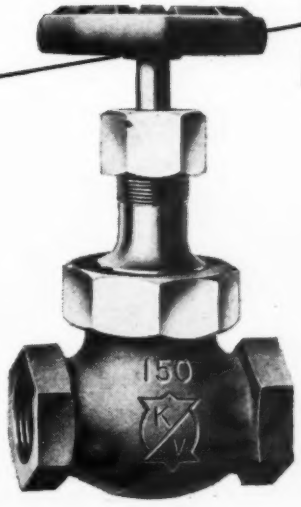
FULL-WAY DISC
Union Bonnet
Renewable Seat Ring

These 200 lb. and 300 lb. valves have renewable discs and seat rings of tough, wear resisting nickel-copper alloy. They can be furnished in special alloys to meet unusually severe service conditions.



PLUG-TYPE DISC
Union Bonnet
Renewable Seat Ring

The extra wide seating surfaces of these 200 lb. and 300 lb. Kennedy valves make them highly resistant to wire drawing. The plug-type disc design assures precise throttling control. Nickel-copper alloy for discs and seat rings are standard. Special alloys for unusual service conditions are available.



In addition to these bronze globe and angle valves, the extensive Kennedy line also includes bronze gate and check valves, iron body gate, globe, angle and check valves, malleable iron and bronze screwed fittings, and cast iron flanged fittings and flanges. Write for Catalog 63, describing all Kennedy products.

BUY FROM YOUR LOCAL DISTRIBUTOR

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valves • pipe fittings • fire hydrants

THE KENNEDY VALVE MFG. CO., ELMIRA, N. Y:
Offices and Warehouses in Principal Cities

KV-163

POWER

EXIDE BATTERIES... for dependable Diesel cranking power

In all climates, at all seasons, in all kinds of weather... thousands of Exide Batteries are proving that their extra power and ruggedness are equal to any Diesel cranking job. They are proving it on trucks, buses and off-the-highway equipment... on ships and railroad locomotives... in power plants and many other applications. They are proving that for dependability, long life and ease of maintenance, you can always count on Exide Diesel Cranking Batteries.

Write today for a FREE copy of the Exide Catalog on Heavy-Duty Batteries. It gives you catalog data and information on how to get the most from your Diesel Cranking Batteries.

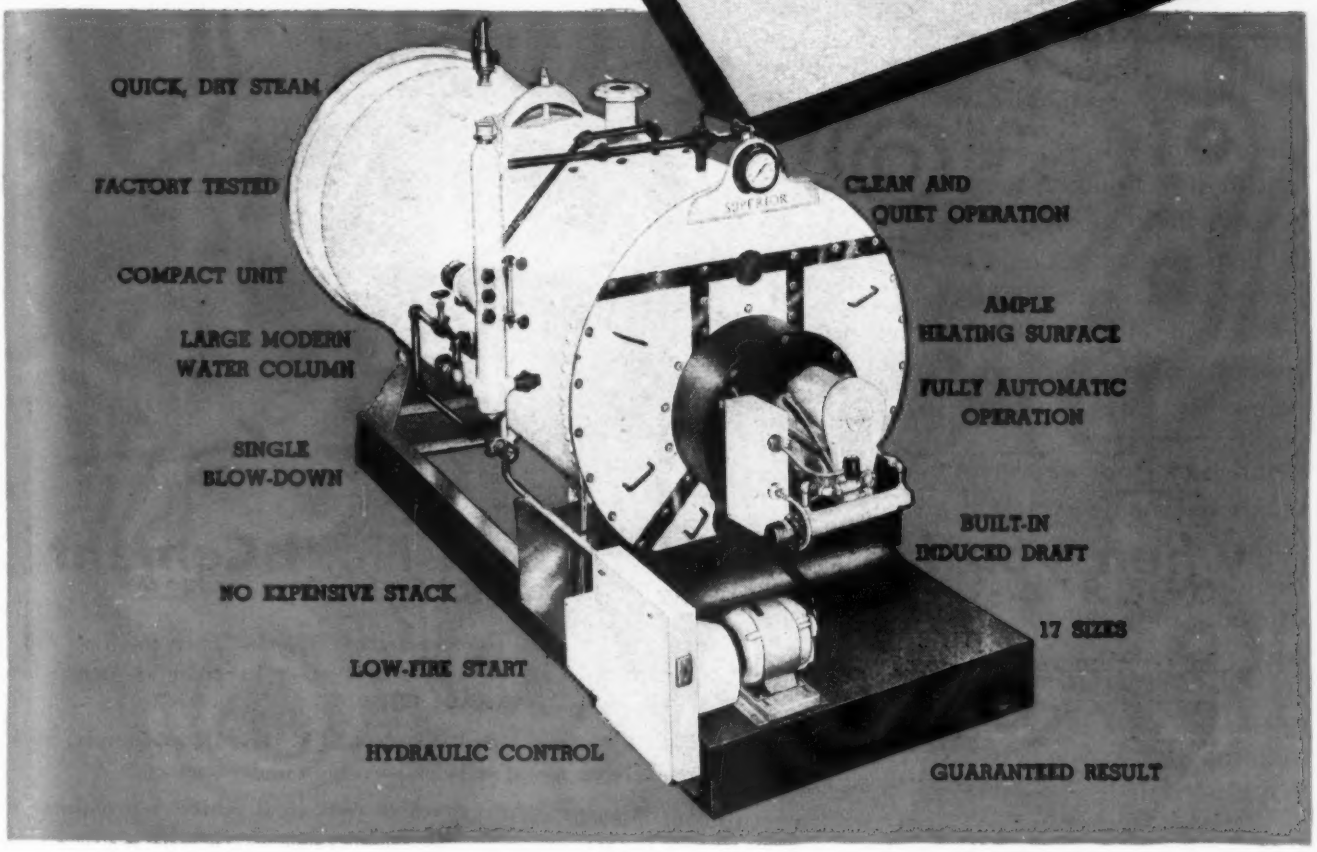
Exide
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • Exide Batteries of Canada, Limited, Toronto

YOU

wrote the specifications for

SUPERIOR *Steam Generators*



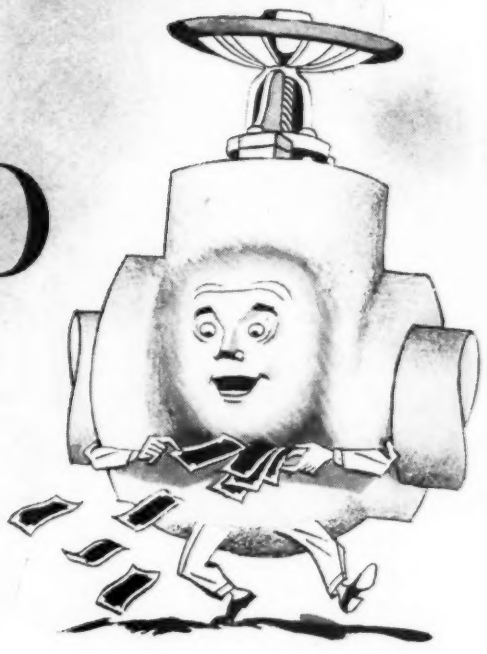
You asked for all of these features when you demanded high efficiency, simplicity and dependability in a "packaged unit steam generator". You insisted that it be capable of fully automatic operation firing all grades of fuel oil including Bunker C. You specified maximum ease of operation, minimum maintenance, smooth and quiet performance, and assurance that the rated output be easily obtained at 80% or more guaranteed thermal efficiency.

Superior Steam Generators bring them all to you in one compact, functionally-designed unit available in 17 sizes, ranging from 20 to 500 b.h.p., generating from 700 to 17,000 lbs. of steam per hour, at pressures up to 200 p.s.i. This is the steam generator which you, America's power engineers, told us you needed. Superior Steam Generators have all the attributes you have asked for in a "packaged unit". Write for fully illustrated Catalog 101 today.

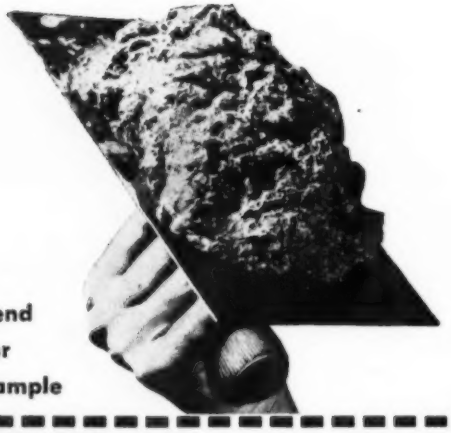
Superior Combustion Industries, inc.

Emmaus, Pa.

heat losses turn into profits



when you insulate with B-H No. 1 Cement



Send for Sample

Looking for ways to cut production costs? Then put B-H No. 1 Cement to work on valves and other irregular surfaces where BTU's are going to waste.

It goes on in a jiffy—simply add water, mix and apply. Sticks instantly on metal or brick—even on under-surfaces.

It stays on—doesn't crack or peel. Rust inhibitor prohibits pitting or corroding of metal surfaces.

It insulates up to 1800° F—because the base is black Rockwool. Just 3 inches of B-H No. 1 cement, for example, reduces 800° surface heat to 150° F.

It's convenient—no loss, breakage or waste. Packed in 50 pound bags ready for instant use. Reclaimable up to 1200° F. The coupon brings descriptive literature and a working sample.

Baldwin-Hill Company
514 Breunig Avenue
Trenton 2, N. J.

Send free sample of B-H No. 1 Cement and data book "Industrial Insulations."

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OTHER B-H INSULATION MATERIALS

B-H Mono-Block—an easy-to-apply, one-block insulation for temperatures up to 1700° F. **B-H Blankets**—for wrap-around insulation of large areas, effective to 1200° F. **B-H Weatherseal**—a weatherproof compound for protecting insulated surfaces.

Baldwin-Hill

Specialists in Thermal Insulation

GOOD NEWS!

WATSON-STILLMAN OFFERS A COMPLETE LINE OF FORGED STAINLESS STEEL PIPE FITTINGS!

Don't delay investigating the current prices and quality of W-S Forged Stainless Steel Pipe Fittings.

You can easily convince yourself as to the favorable cost comparison of W-S fittings in *forged* stainless steels with other types of stainless fittings; and at the same time you will discover their many service advantages in both low and high pressure-temperature installations. Your inquiry involves no obligation, of course.

The W-S *forged* stainless steel line is complete in both screw-end and socket welding types. Both these classifications can be furnished in AISI types 304, 347, and 316, for use with schedules 40, 80, 160 and double extra-heavy pipe.

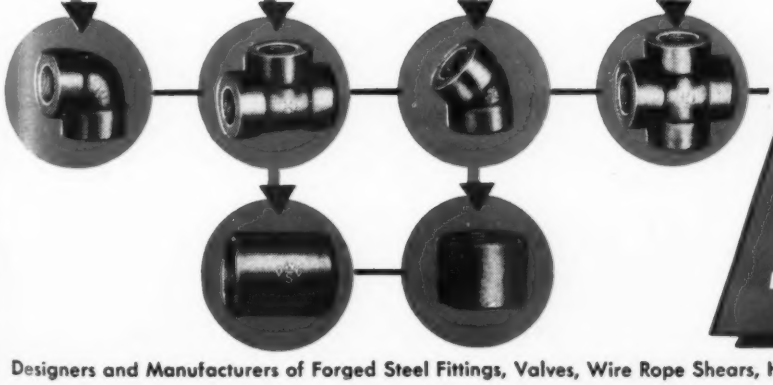
Write on your letterhead today for complete information contained in free 44-page Bulletin A-3.

WATSON-STILLMAN CO.

Roselle, New Jersey

Sold through Leading Industrial Distributors

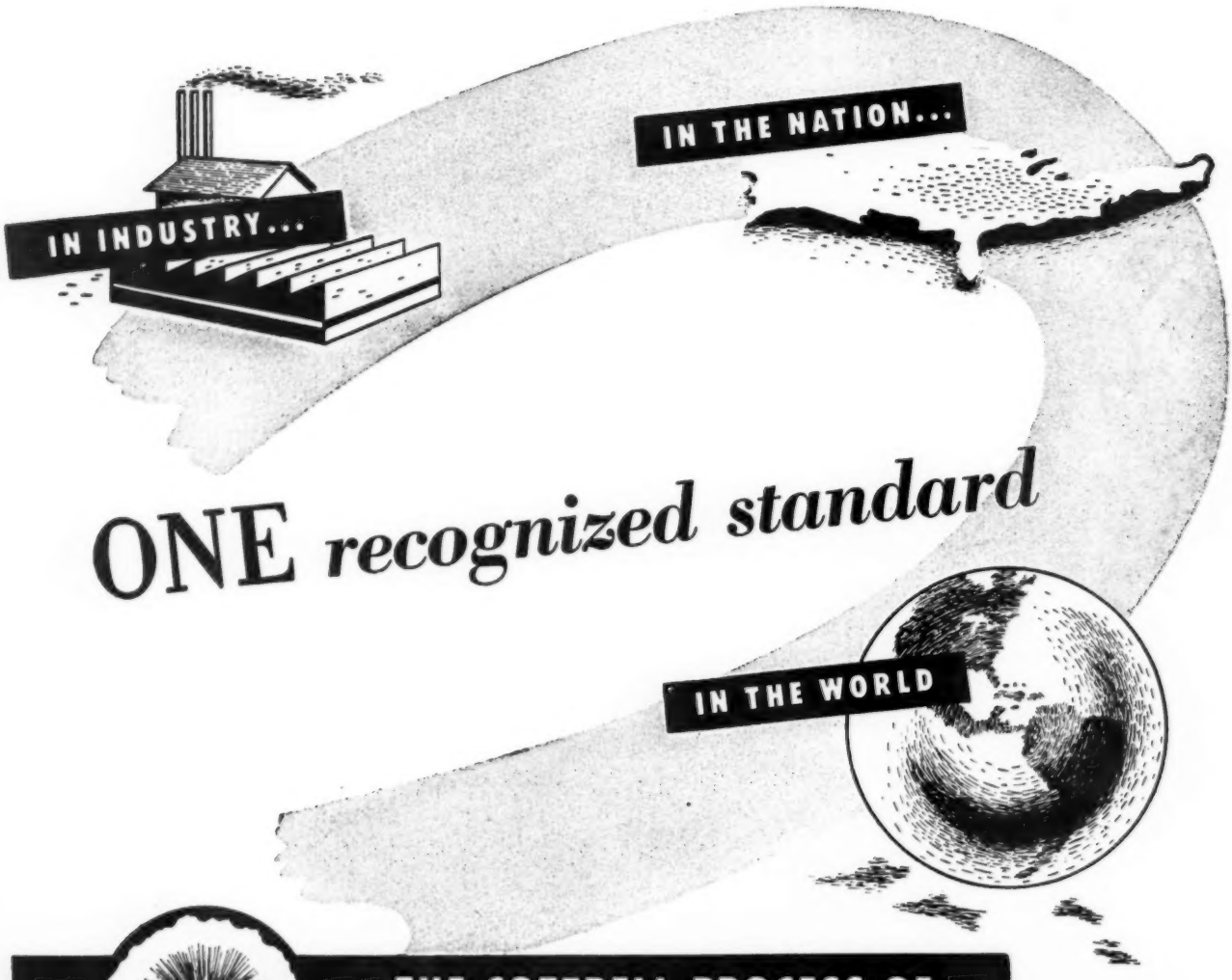
3395



WATSON-STILLMAN

DISTRIBUTOR PRODUCTS DIVISION
ESTABLISHED 1848

Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment



ONE *recognized standard*

THE COTTRELL PROCESS OF ELECTRICAL PRECIPITATION

FOR GAS CLEANING, smoke abatement and removal of dust, fume, tar and other suspended matter from gas, there has been one universally accepted process for more than thirty years. In answer to your special problem, a Cottrell installation incorporating this rich experience in research, development and worldwide operation means the complete fulfillment of your requirements.

RESEARCH CORPORATION

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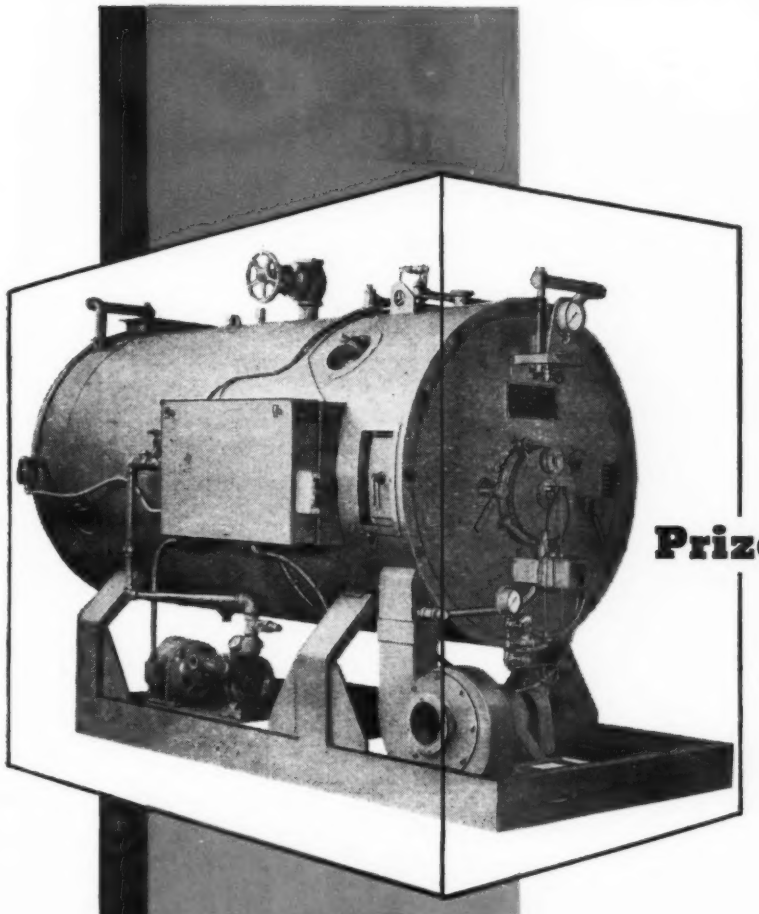


Prize Package of Power!

AMESTEAM GENERATOR

Manufactured under License in Canada by VOLCANO, Ltd., Montreal

The AMESTEAM Generator is a prize package of power in every sense of the word.

It provides low-cost steam, year after year, with minimum manpower and maximum efficiency. It can be easily and quickly installed, all parts are readily accessible for quick repair when necessary, and it is easy to operate because of its automatic features.

Designed for any power or process load, and manufactured with the skill that only 100 years of experience can develop, the AMESTEAM Generator will live up to all your expectations.

Regularly furnished in sizes from 10 to 300 horsepower for any of the commercial grades of fuel oil or gas, or combinations of oil and gas.

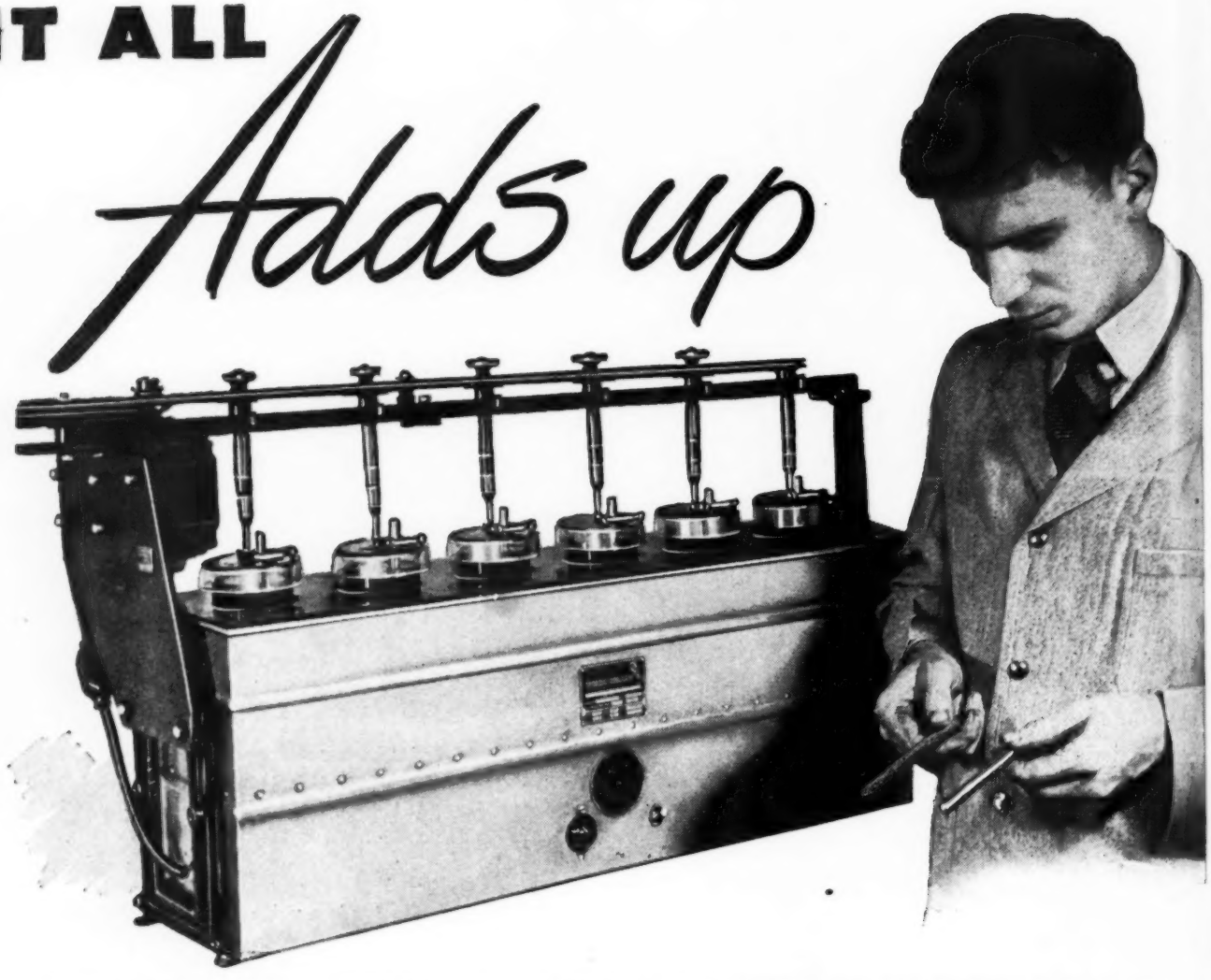
Write, wire or phone today for full details.

A complete Return to the Boiler System including Feed Water Pump and Condensate Tank with their accessories, is part of the standard equipment with every AMESTEAM GENERATOR.

AMES IRON WORKS

BOX B10 OSWEGO, NEW YORK

IT ALL *Adds up*



Where special qualities are essential for safe, enduring industrial lubrication, Sinclair Research develops additives that will "further improve the best".

Pictured above is one apparatus used by Sinclair Research to determine the rust-inhibiting efficiency of oils manufactured for turbine use. Chemical additives are studied to provide such protection against rust. Obviously, the treated oil sample used on the metal rod in the technician's left hand has high rust-inhibiting efficiency and prevented the deposit shown on the other rod.

All Sinclair Research and Refinery Control is similarly thorough. *It all adds up* . . . to assure you of lubricant qualities essential to efficient and economical industrial maintenance in all applications.

Sinclair Power Plant Lubricants
FOR MINIMUM FRICTION—MAXIMUM POWER
For Turbines:
SINTURLITE OILS
For Steam Cylinders:
SINCLAIR STEAM CYLINDER AND VALVE OILS
For Compressors:
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For Ball and Roller Bearings:
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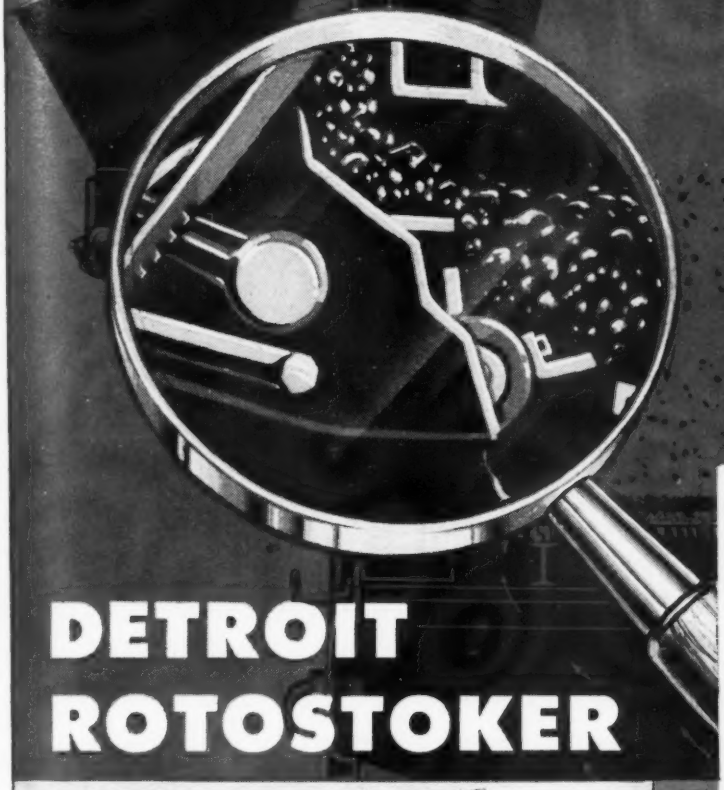
SINCLAIR REFINING COMPANY • 630 FIFTH AVENUE, NEW YORK 20, N. Y.

SINCLAIR

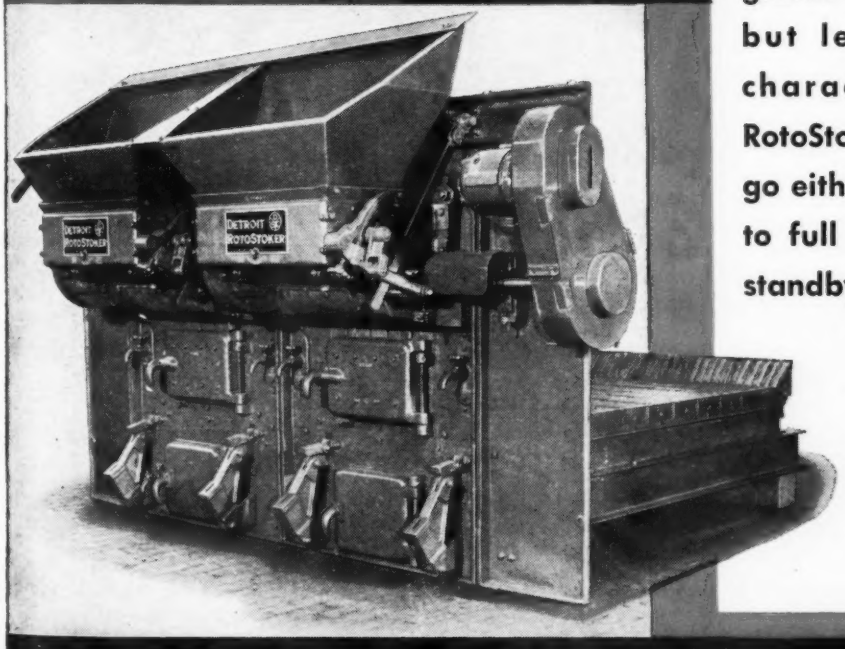
Lubricants for Industry

FINEST CRUDES + EXPERT RESEARCH and MANUFACTURING CONTROL = OUTSTANDING PERFORMANCE

It's the OVERTHROW ROTOR *that does the* TRICK



DETROIT ROTOSTOKER



A spreader stoker with an **OVERTHROW ROTOR** that assures dependable and uniform fuel distribution. Fuel is burned partially in suspension and partially on the grates with a comparatively thin, but level fuel bed. Burning characteristics are such that RotoStoker equipped boilers can go either from a banked condition to full load—or from full load to standby in a few minutes. Banking losses are negligible, as only a small amount of coal is carried on the grates at any time.

Write for Bulletin.

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

District Offices in Principal Cities • Works at Monroe, Michigan

CMH ENGINEERED

EXPANSION JOINTS

For dependable expansion, vibration, and misalignment control in your pipe lines

HERE is a series of dependable copper and stainless steel expansion joints to solve problems of expansion, vibration, and misalignment in pipe lines... to do a real professional job in your plant.

CMH-engineered curvature of corrugations provides maximum flexibility and resistance to metal fatigue. Control rings on CMH Controlled-Flexing Joints are corrugation-mated to assure perfect control under all operating conditions. Chicago Metal Hose pioneered in the manufacture of stainless steel bellows and CMH Expansion Joints design is an outgrowth of this wide experience and acknowledged leadership in the science of FLEXONICS*. This experience is your assurance of the best guidance in the selection and installation of your expansion joints.

CMH Expansion Joints are available in sizes from 4" to 24" inside diameters; in single and multiple corrugation types; Free-Flexing and Controlled-Flexing; with or without monel or stainless steel inner liners; for pressures up to 300 p.s.i. and temperatures to 900° F.

Bulletin EJ-47 illustrates CMH Expansion Joints and gives you the technical data necessary to choose the right CMH Joints for your particular needs. Write for your copy today.

*the science of FLEXONICS . . ."the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion"... is exemplified in the basic products of Chicago Metal Hose Corporation.

"FLEXON" *identifies CMH proaucts, which have served industry for more than 45 years.*

COPPER AND STAINLESS STEEL

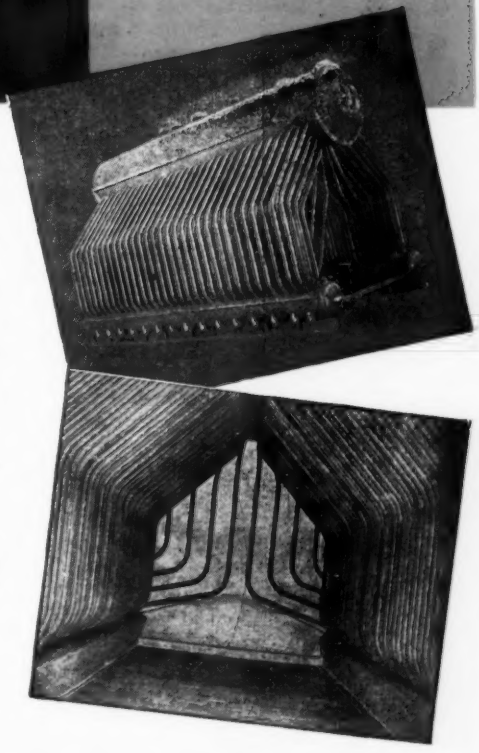
CMH CHICAGO METAL HOSE CORPORATION
Expansion Joint Division
Maywood, Illinois · Plants: Maywood and Elgin, Illinois

PACKAGE POWER EFFICIENCY FOR YOUR PLANT

WITH WICKES

CROWN TYPE-A BOILERS

- Specially designed so that each furnace wall is a separate steam generator as well as an integral part of boiler unit.
- Drums fully protected against intense furnace heat.
- Front and rear refractory surfaces protected with waterwalls.
- No complicated headers or circulating tubes to require frequent maintenance and repair.
- Conserve head room and floor space.



WICKES PACKAGE CROWN TYPE-A BOILERS typify the combined engineering knowledge and expert workmanship that for nearly a century have distinguished all Wickes products. Patterned after our line of large Crown Type-A Boilers, the Package Unit is engineered for pressures up to 500 p.s.i. and for capacities of 20 to 250 nominal horsepower. Compact, efficient, they are produced as a steel-cased package unit and are shipped ready for operation with a minimum of installation problems. Send us your boiler requirements and our engineers will be glad to determine how Wickes Crown Type-A or other Wickes boilers can increase power efficiency in your plant.

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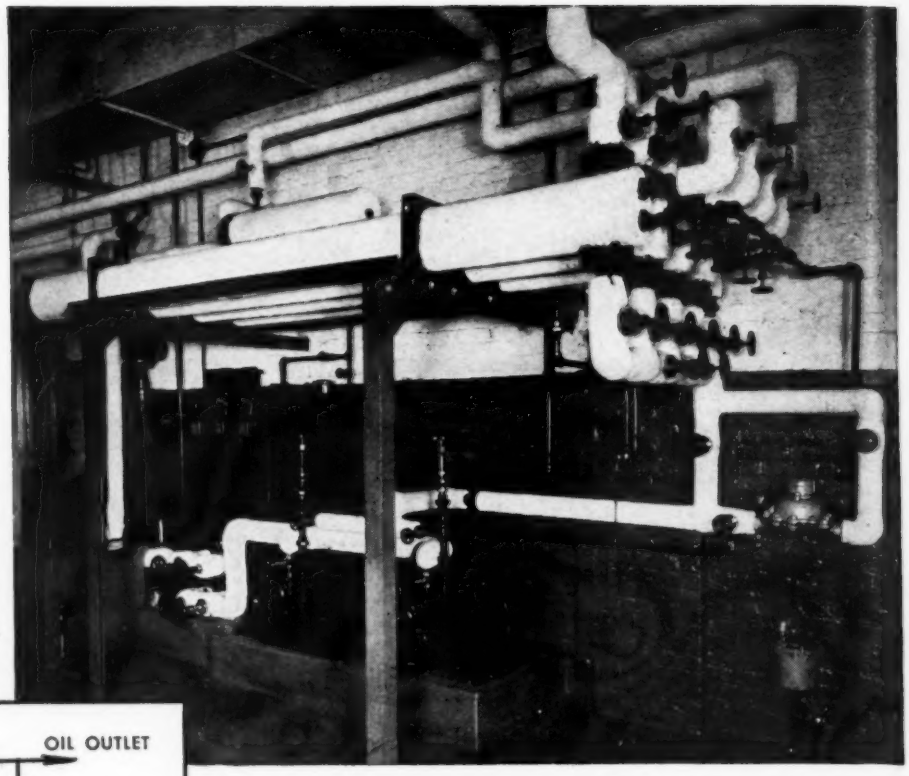
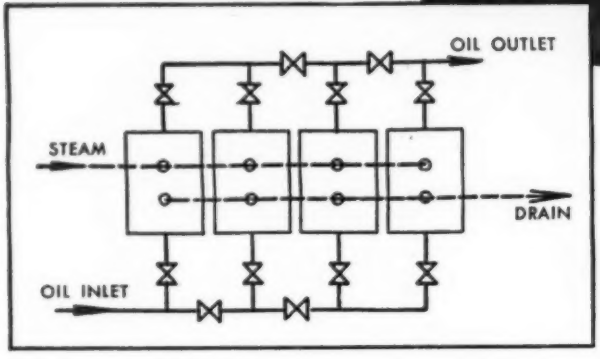
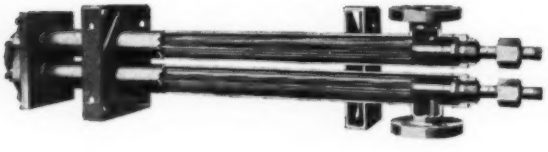
THE WICKES BOILER CO.

SAGINAW, MICHIGAN, U.S.A. • RECOGNIZED QUALITY SINCE 1854

G-R TWIN G-FIN SECTION







The Twin G-Fin Section is the simplest form of heat exchanger; namely, a pipe within a pipe. The inner pipe is the G-Fin element, the outer pipe serves as the shell, and the complete unit is in the form of a patented and exclusive "hair-pin" design.

This unit is further distinguished by the longitudinal fins of the G-Fin elements which provide an extension of the exterior heat transfer surface of the element. These fins compensate for the lower heat conductivity of the oil to be heated as compared to the higher heat conductivity of the steam used as the heating medium, thereby making the unit more efficient, compact, and economical than a conventional bare-tube heater for the same service.

. . . the FUEL OIL HEATER that permits FLEXIBILITY for fractional loads

Here is a *sectional* fuel oil heater that will enable you to better maintain constant oil temperatures, no matter what the load.

For example, the installation illustrated above consists of a bank of four units, arranged so that any two, three or four units can operate in series or parallel.

At full load, any three units can be operated, with one unit as a spare. Cutting out one or two units from the line controls the heating effect for two-thirds or one-third load conditions . . . a flexibility which is not obtainable with other types of heaters. Also, at any load, the section or sections which are not used may be inspected or cleaned without shutting down the entire fuel oil heater installation.

This unequalled flexibility is but one of many distinctive features of the G-R Twin G-Fin Section Fuel Oil Heaters that provide maximum simplicity, ease of installation and dependable operation. Write for Form 714 describing these units in detail.

THE GRISCOM-RUSSELL CO.
285 Madison Avenue, New York 17, N. Y.

GR-183

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Since 1926 this S-A Conveyor system, on the Pine Ridge Coal Co., Detroit waterfront dock, has unloaded, stored, screened and delivered coal . . . with practically no repairs. It's still good for millions more tons.

For Similar Service and Economy...Get S-A Conveyors

This S-A Conveyor system is not an exception. Exposed to dust and every kind of weather it has handled an average of 300,000 tons of coal each year.

When loaded boats dock, the coal must be unloaded fast—1500 tons per hour—to return for new pay loads without wasting time of expensive equipment.

The idlers or carriers on which the Pine Ridge Conveyor belts travel are Sacons. Live shafts turn with rollers in ball bearings to save bearing travel, and starting and running power. The bearings are enclosed in self-aligning housings, with dust and weather tight labyrinth grease seals. They are built to take punishment... in this case, millions of tons... with practically no repairs or replacements.

Get the Best...Get S-A

For valuable assistance on selecting the right type of bulk material handling equipment, talk to an S-A engineer, or write us today.

STEPHEN S-A ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. • BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

Mount this gearmotor in any position—Timken bearings keep gears meshing properly

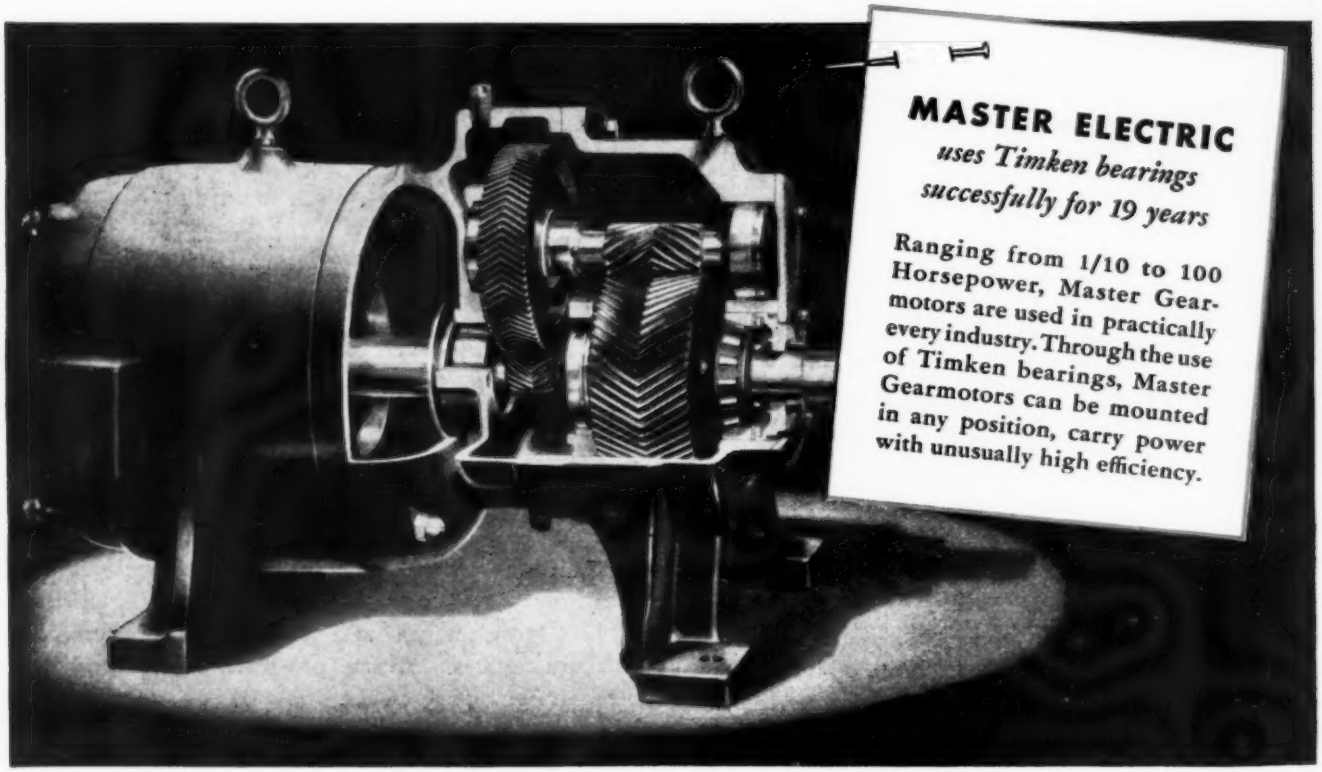
NO matter in what position this Master Gearmotor is mounted, gears mesh smoothly. One big reason: Timken tapered roller bearings in the gear mechanism.

The tapered construction of Timken bearings lets them take any combination of radial and thrust loads. So whatever loads are imposed on the bearings due to the position of the motor, shafts and gears are held in rigid alignment, smooth frictionless rotation is assured. Power losses in Master Gearmotors have been held to an absolute minimum—an achievement which would be impossible were the bearings not practically frictionless.

Timken bearings are made of the finest steel ever developed for anti-friction bearings—Timken fine alloy steel. They're manufactured to incredible precision, finished to amazing smoothness. Timken bearings normally outwear the machine itself. Be sure they're in the machines you buy or build. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.



MASTER ELECTRIC
uses Timken bearings successfully for 19 years

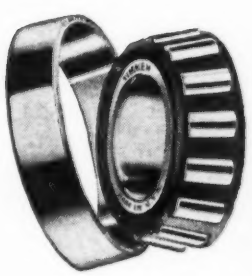
Ranging from 1/10 to 100 Horsepower, Master Gearmotors are used in practically every industry. Through the use of Timken bearings, Master Gearmotors can be mounted in any position, carry power with unusually high efficiency.

DESIGN LEADERSHIP

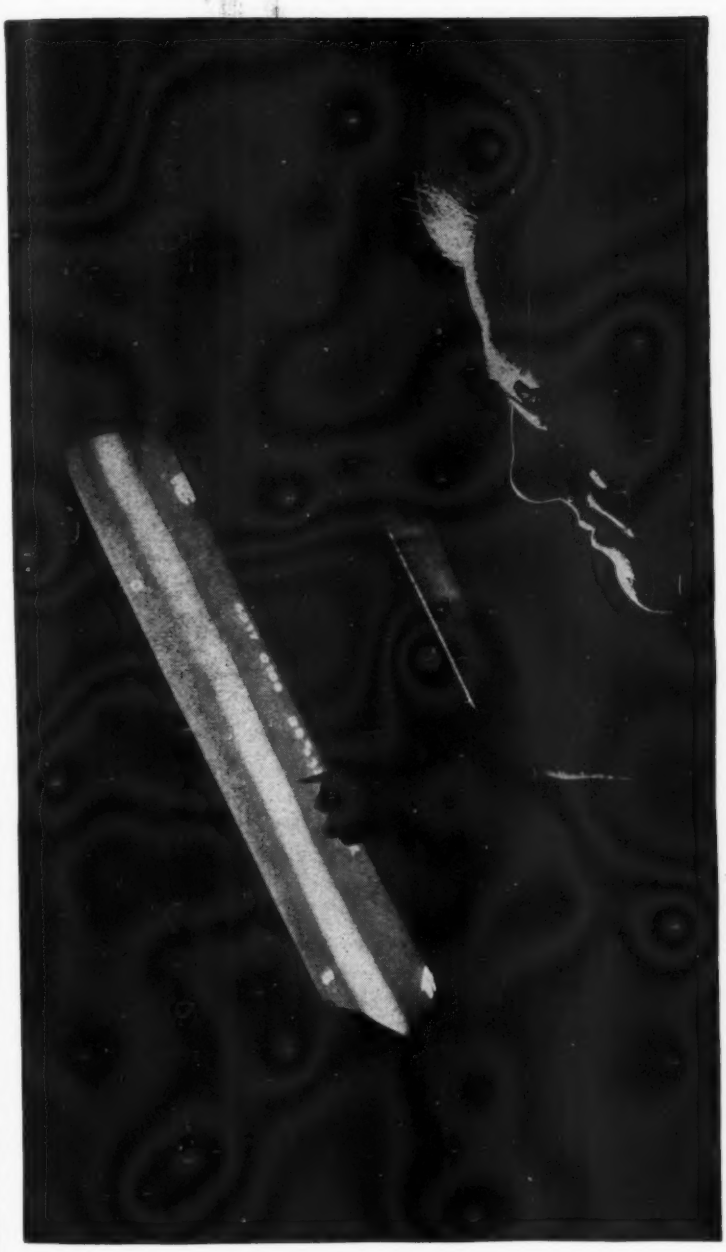
The first Timken tapered roller bearing was produced about 1898. Since then the one-piece multiple perforated cage, wide area contact between roll ends and ribs, and every other important tapered roller bearing improvement have been introduced by The Timken Roller Bearing Company.

The Timken Roller Bearing Company is the only bearing manufacturer in the country which makes its own steel, and leads in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

TIMKEN
TRADE MARK REG. U.S. PAT. OFF.
TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◐ AND THRUST ◐ LOADS OR ANY COMBINATION ✳



1,000 X-Rays a day to avoid one possible flaw...

An expert welder may make 1,000 perfect passes before one minute flaw shows up. Kellogg doesn't risk even that one chance in a thousand!

To begin with, every welder in the Kellogg shops must qualify for X-ray inspected work. In addition to constant routine supervision on the floor, as many as 1,000 X-rays of welds are made daily to prevent that one tiny flaw from slipping through. No welder knows which jobs will be X-rayed and which won't. Every weld is made with the expectation that it *will* be subjected to the penetrating eye of the X-ray machine—*and that's the way we want it!*

This exhaustive X-ray inspection is part of the unseen quality that goes into all Kellogg Fabricated Products—one of the reasons why so many jobs—where perfection is all important—are entrusted to Kellogg.

FABRICATED PRODUCTS DIVISION

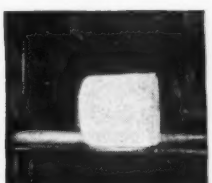
THE M. W. KELLOGG COMPANY

NEW YORK • JERSEY CITY • BUFFALO • LOS ANGELES
TULSA • HOUSTON • TORONTO • LONDON • PARIS

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.



Complete Facilities for fabricating of steel products from simple forgings to the most intricate 120 foot towers.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.

Top Welding Performance assured by specially designed equipment . . . exclusive employment of master operators.

They struck it rich in their parlor

We can't all be lucky and win radio prize contests, but we can enjoy top entertainment at the lowest possible cost . . . *an average of less than half a penny an hour!*

Your radio is just one example of how low cost, abundant electric power works for you day and night.

Just luck? Not by a long shot. Wide-awake, far-sighted planning to widen distribution and lower costs is traditional with America's electrical industry. Throughout its long and close association with the industry, American Blower has continually worked with producers of power to increase production efficiency.

American Blower manufactures three major groups of power plant products: Mechanical Draft Fans, Fly Ash Precipitators and Gyrol Fluid Drives. Gyrol Fluid Drives are the remarkable new shockless power transmission method for adjustable speed control of mechanical draft fans and boiler feed pumps.

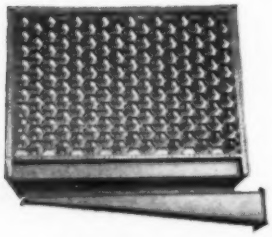
If you are contemplating plant modernization or new construction—why not call in American Blower now? Write or phone the nearest American Blower office. They are conveniently located in 57 principal cities of the United States and Canada.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICH.
In Canada: CANADIAN SIROCCO CO., LTD., WINDSOR, ONT.

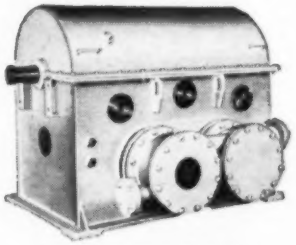
AMERICAN BLOWER

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

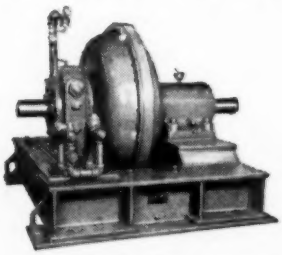
4 American Blower Products to improve overall power plant efficiency



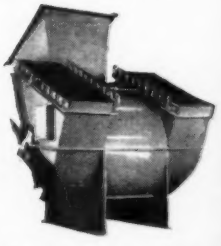
ST Fly Ash Precipitators —especially for power plants burning powdered fuel.



Type VS Class 6 Gyrol Fluid Drive—for adjustable speed control of boiler feed pumps.



Type VS Gyrol Fluid Drive—for adjustable speed control of mechanical draft fans.



HS and Sirocco Fans for forced or induced draft in all types of power plants.

Here's why these Fans LAST LONGER-

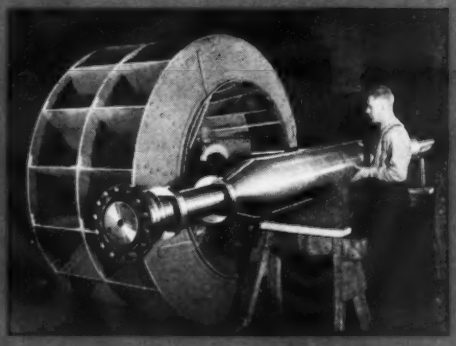
Note "long life" features in this "Buffalo" housing. Made of heavy plate, hot-riveted together, it has cast iron scroll liners inside. Entire structure is stiffened with channels and I-beams.

Every operating engineer knows that an Induced Draft Fan can't "last forever"—the point of economy and efficiency being to get a fan that will:

1. Stand up as long as possible.
2. Be of construction that allows ready replacement of parts.

"Buffalo" engineers early recognized these frank "facts of life" in designing the Induced Draft Fans that today help to keep hundreds of power plants going dependably and at minimum cost.

In "Buffalo" Induced Draft Fans, you will find PLENTY OF METAL where wear and erosion are bound to occur—extra heavy gauge housings and blades—extra husky rotors and shafts—a "metal bonus"—to keep fans running.

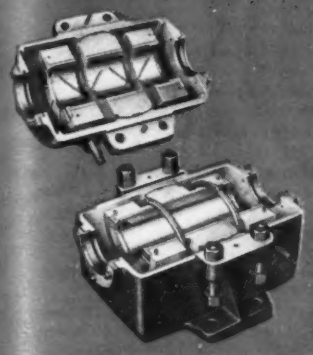


Rotor and shaft are dynamically balanced. Blades are double-riveted to flange and center plate (which are of 1" alloy steel).

"You'll note, too, that their overall accessible construction reduces "time-outs" when it comes to replacing ash-eroded parts.

Add typical "Buffalo" precision rotor balance—scientifically correct shaping and proportioning of blades—proper scroll design—and you have EFFICIENCY that delivers MORE AIR AT LESS COST!

Write now for engineering data on these long-life fans—Bulletin 3190-B.

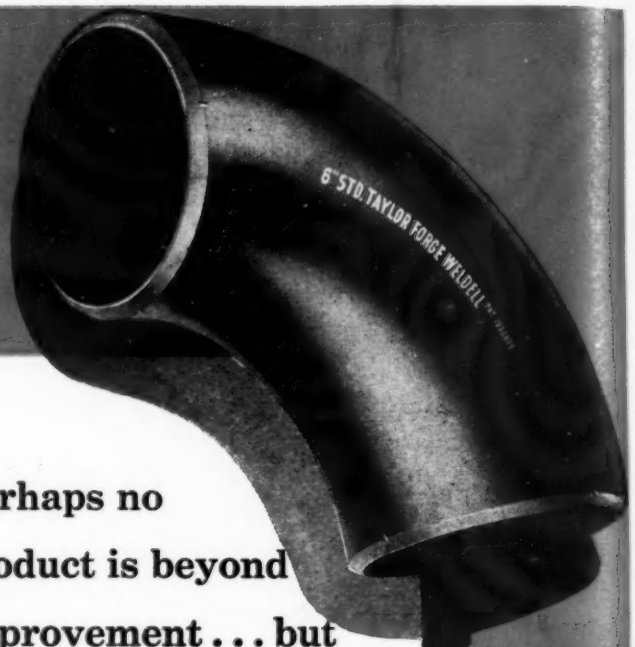


Bearings built to take a beating! These are water-cooled and self-aligning. Thrust collars are enclosed, running on babbitted and lubricated shoulders.

BUFFALO FORGE CO.
488 BROADWAY BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" INDUCED DRAFT FANS

WeldELLS *have everything**



Perhaps no product is beyond improvement . . . but the fact remains that WeldELLS do combine features (listed below) which place them beyond all other fittings for pipe welding.

* **WeldELLS alone combine these features:**

- **Seamless—greater strength and uniformity.**
- **Tangents—keep weld away from zone of highest stress—simplify lining up.**
- **Precision quarter-marked ends—simplify layout and help insure accuracy.**
- **Selective reinforcement—provides uniform strength.**
- **Permanent and complete identification markings—saves time and eliminates errors in shop and field.**
- **Wall thickness never less than specification minimum—assures full strength and long life.**
- **Machine tool beveled ends—provides best welding surface and accurate bevel and land.**
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World—insures complete service and undivided responsibility.**

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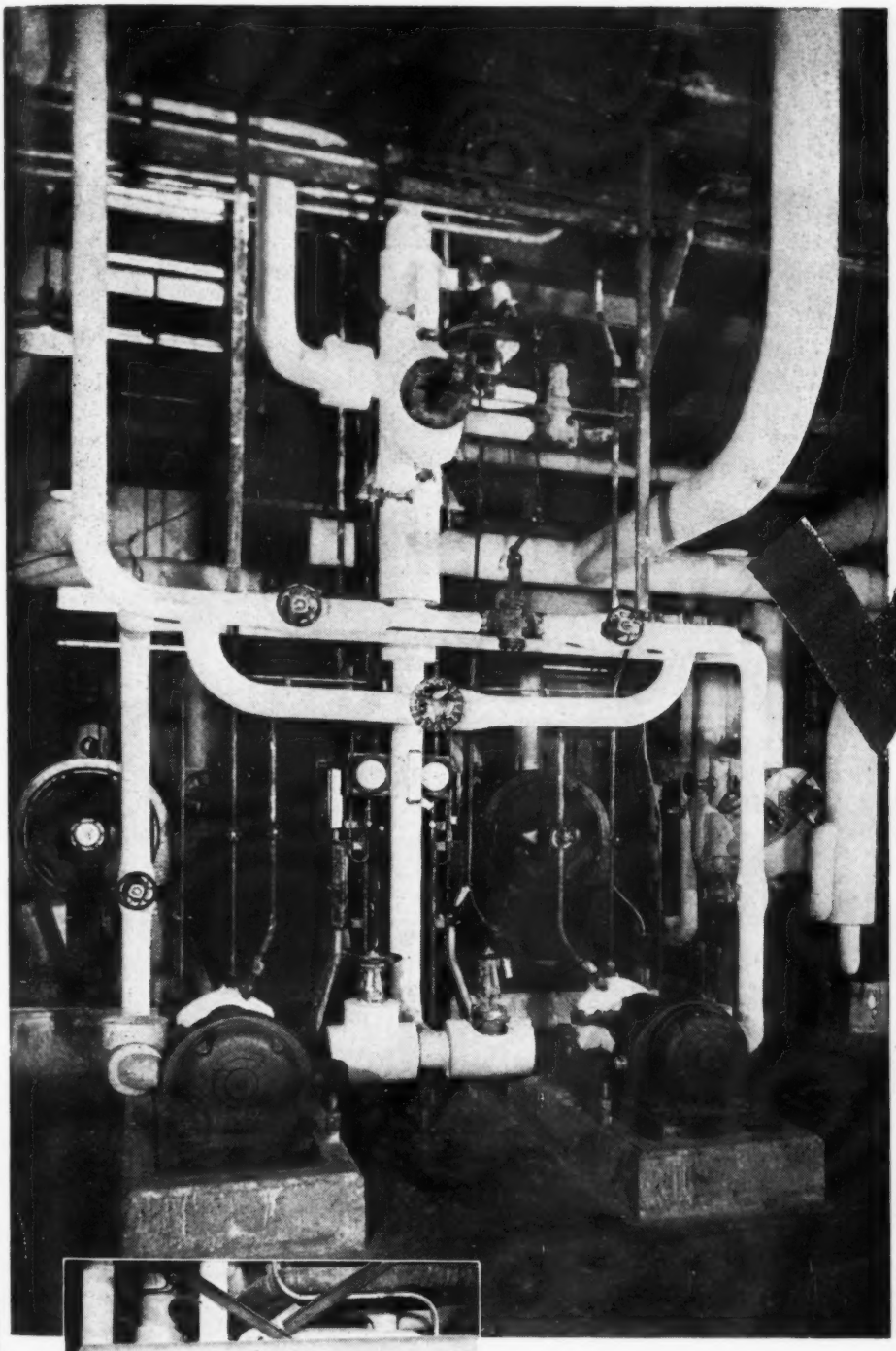

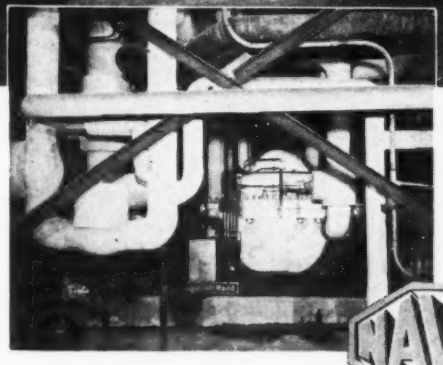

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✓Opened or Closed by a Quarter Turn?
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✓Protected Seating Surfaces?
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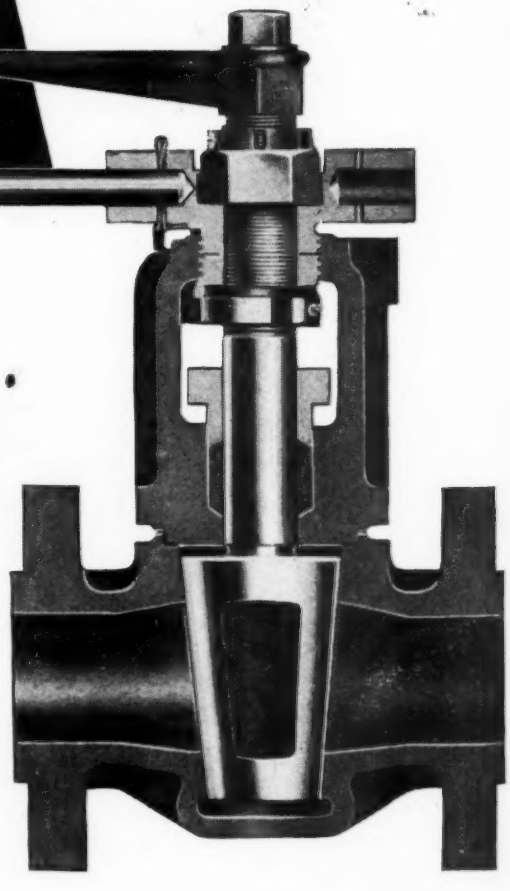
HOMESTEAD *LEVER-SEALD* VALVES



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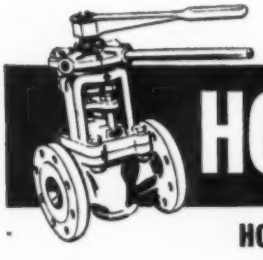
Operation is simple and easy. Seating pressure is first relieved with the lower lever just enough to overcome friction. Then a quarter-turn of the upper lever fully opens or closes the valve. Full seating pressure is again applied with the lower lever to make a positive, leakless seal. They operate faster, too . . . 16 to 28 times faster than screw-stem-type valves. The quarter-turn principle makes them ideal for installation in restricted areas, next to walls, floors, ceilings, congested piping and other obstructions where many other types of valves could not be operated.

Homestead Lever-Seald Valves are available in combinations of metals and alloys to meet your service requirements. Sizes range from 1¼" to 10" for pressures from vacuum to 1500 pounds.

For complete details write for Valve Reference Book No. 38 . . . today.



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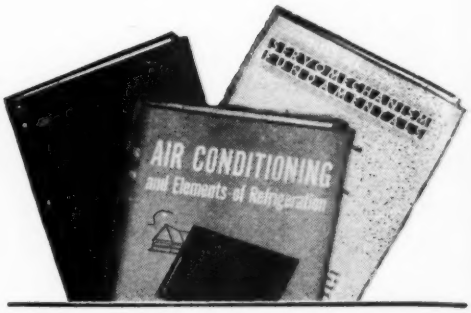

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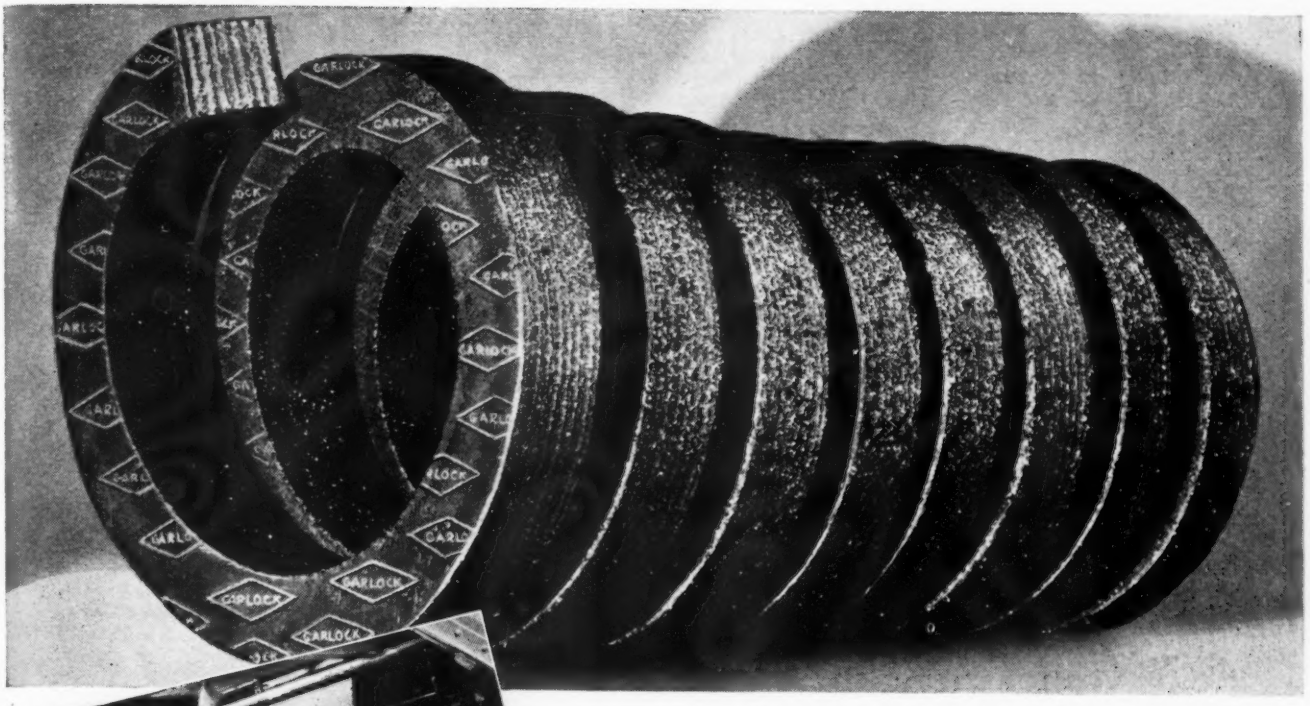

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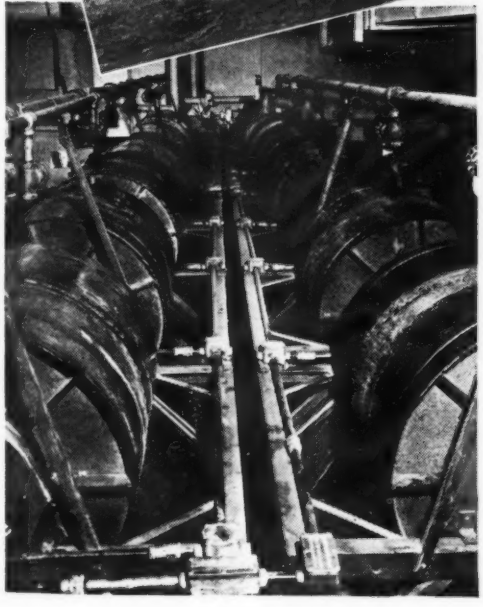

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Center photo shows one of the rubber mills at the Garlock factory.

Bottom photo shows a battery of rubber cement mixing tanks.

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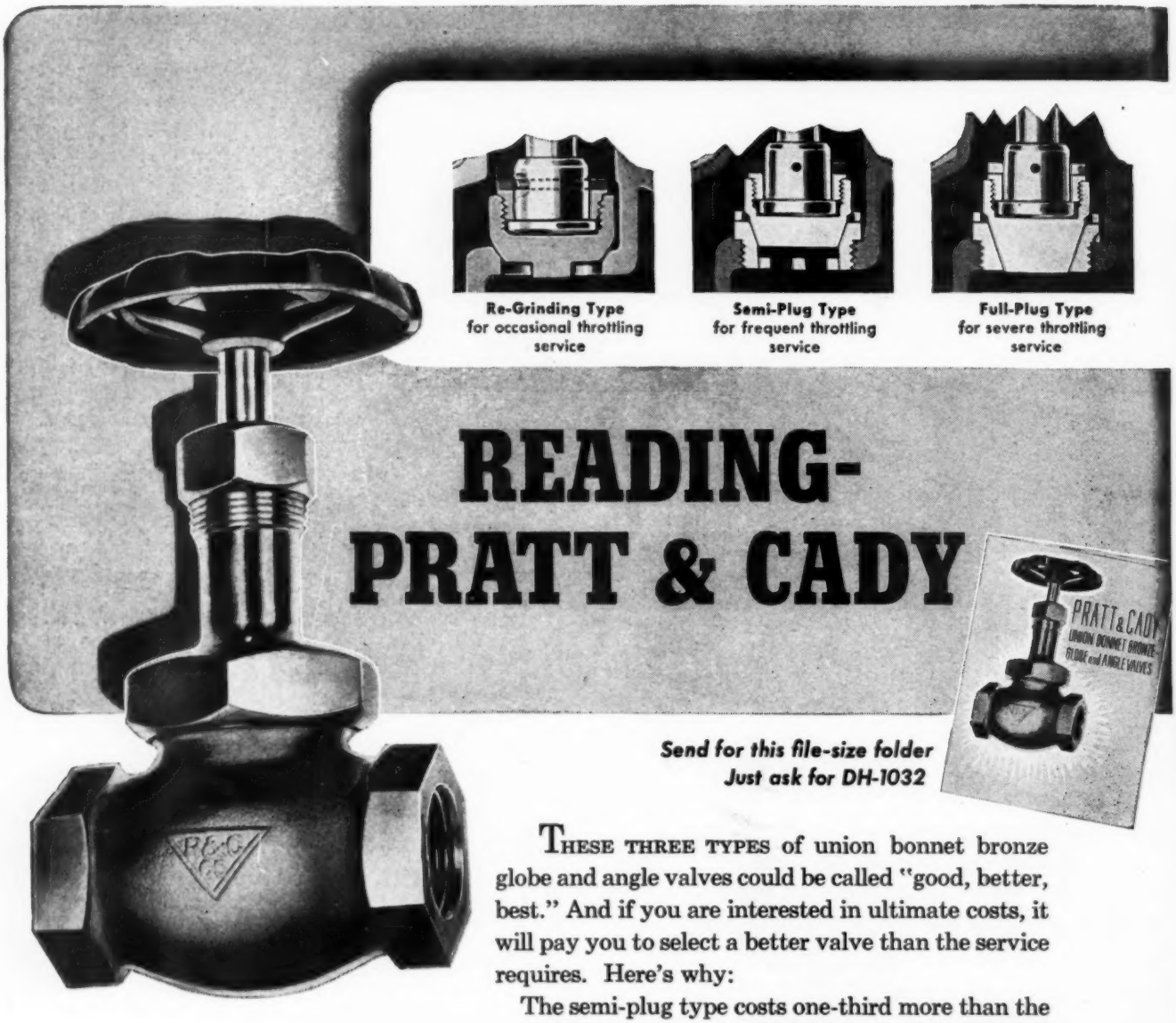
HOW TO GET LONGER SERVICE FROM GLOBE AND ANGLE VALVES



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THESE THREE TYPES of union bonnet bronze globe and angle valves could be called "good, better, best." And if you are interested in ultimate costs, it will pay you to select a better valve than the service requires. Here's why:

The semi-plug type costs one-third more than the re-grinding type—lasts four times as long. The full plug type costs two-thirds more than the re-grinding —lasts eight times as long.

These figures are, of course, approximate. But they do serve to illustrate a point. And the point is —get in touch with your Reading-Pratt & Cady distributor for bronze globe and angle valves.

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Pipe bending looks simple . . .

. . . but to the engineer designing a power installation for extreme operating pressures and temperatures each piping element is a live thing requiring exacting care in its design and fabrication. Potential success or failure for the whole project is wrapped up in each piece of power piping.

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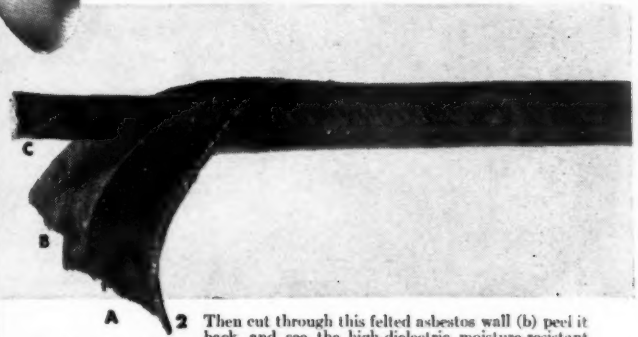
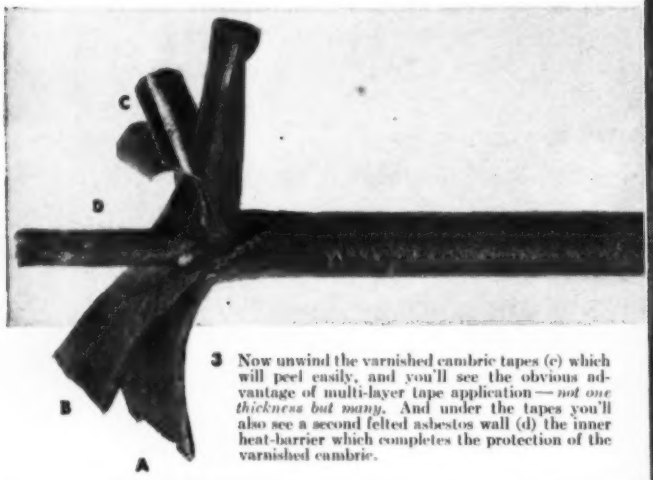
BLAW-KNOX POWER PIPING

For Resistance to Heat and Fumes LOOK Beneath the Braid

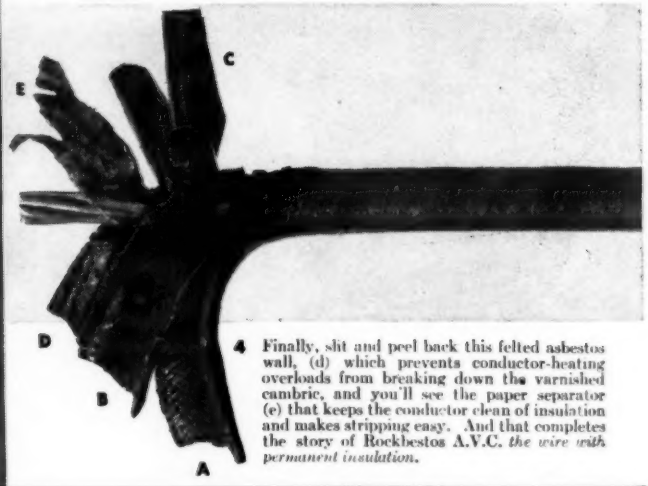
1 Take a sample of Rockbestos A.V.C. Power Cable, illustrated, or similarly insulated Motor Lead Cable, slit open the heavy asbestos braid (a), which is resistant to heat, flame, moisture, oil, and grease, and you'll find beneath a firewall of felted asbestos (b) a permanent heat-barrier against high ambient temperatures.



2 Then cut through this felted asbestos wall (b) peel it back, and see the high-dielectric moisture-resistant varnished cambric tape (c) it protects from heat, flame and oxidation. Notice, too, the uniform coverage of the tapes, helically applied like the felted asbestos to assure perfect and permanent centering of the conductor in the insulation.



3 Now unwind the varnished cambric tapes (c) which will peel easily, and you'll see the obvious advantage of multi-layer tape application — *not one thickness but many.* And under the tapes you'll also see a second felted asbestos wall (d) the inner heat-barrier which completes the protection of the varnished cambric.



4 Finally, slit and peel back this felted asbestos wall, (d) which prevents conductor-heating overloads from breaking down the varnished cambric, and you'll see the paper separator (e) that keeps the conductor clean of insulation and makes stripping easy. And that completes the story of Rockbestos A.V.C. *the wire with permanent insulation.*

A casual inspection isn't enough when it comes to selecting wire and cable for performance in hot-spot service. You've got to look *beneath* the braid! When circuits must operate next to boilers, furnaces, steam lines, drying ovens, resistor grids and soaking pits it is vitally important that the wire is *completely* insulated to withstand heat and moisture, corrosive fumes, oil, grease and flame.

The photos and text above tell the "inside story" of the reasons why Rockbestos A.V.C. Power, Motor Lead and Lighting Wires and Cables (National Electrical Code, Type AVA) will protect circuits and reduce maintenance . . . why their *permanent insulation* makes possible *continuous operation* at 230° F., under varied severe conditions without baking brittle, flowing or rotting.

Send for a sample, look beneath the braid, and see for yourself why Rockbestos A.V.C. gives more service per foot in the worst places. Several types for power, lighting and control circuits, switchboards and equipment, in 600 to 5,000 volt ratings. Just ask for what you are interested in. Write to:

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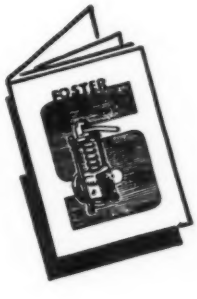
THIS NEW SAFETY VALVE

SAVES MONEY ON EVERY POP!

The Foster Type 38-SV Super-Jet Safety Valve for pressures up to 3000 pounds and temperatures up to1000° F.

Because it reseats as close as 1% below popping pressure, the Foster 38-SV Super-Jet Safety Valve saves steam—saves *money*—on every pop. This new valve blows off only enough steam for safety . . . then reseats positively, without pounding or chatter.

But steam economy is only one advantage of this new safety valve. It is virtually unaffected by changes in temperature—once set under operating conditions, its popping point is constant. It gives full rated nozzle capacity at popping pressure—with negligible accumulation. Full opening is practically instantaneous—reseating is positive, without flutter or rebound even after sustained or successive lifts. And blowdown is adjustable from 8% down to 1% without chatter or pounding because steam cannot accumulate above valve disc.



The Foster 38-SV Safety Valve was especially designed for pressures up to 3000 pounds and temperatures up to 1000° F. In fact, they are now being tested at temperatures considerably above 1000° F. Investigate its many features and advantages by writing for Bulletin 25 today.

FOSTER ENGINEERING Company

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FOR ACCURATE FLUE GAS CONTROL

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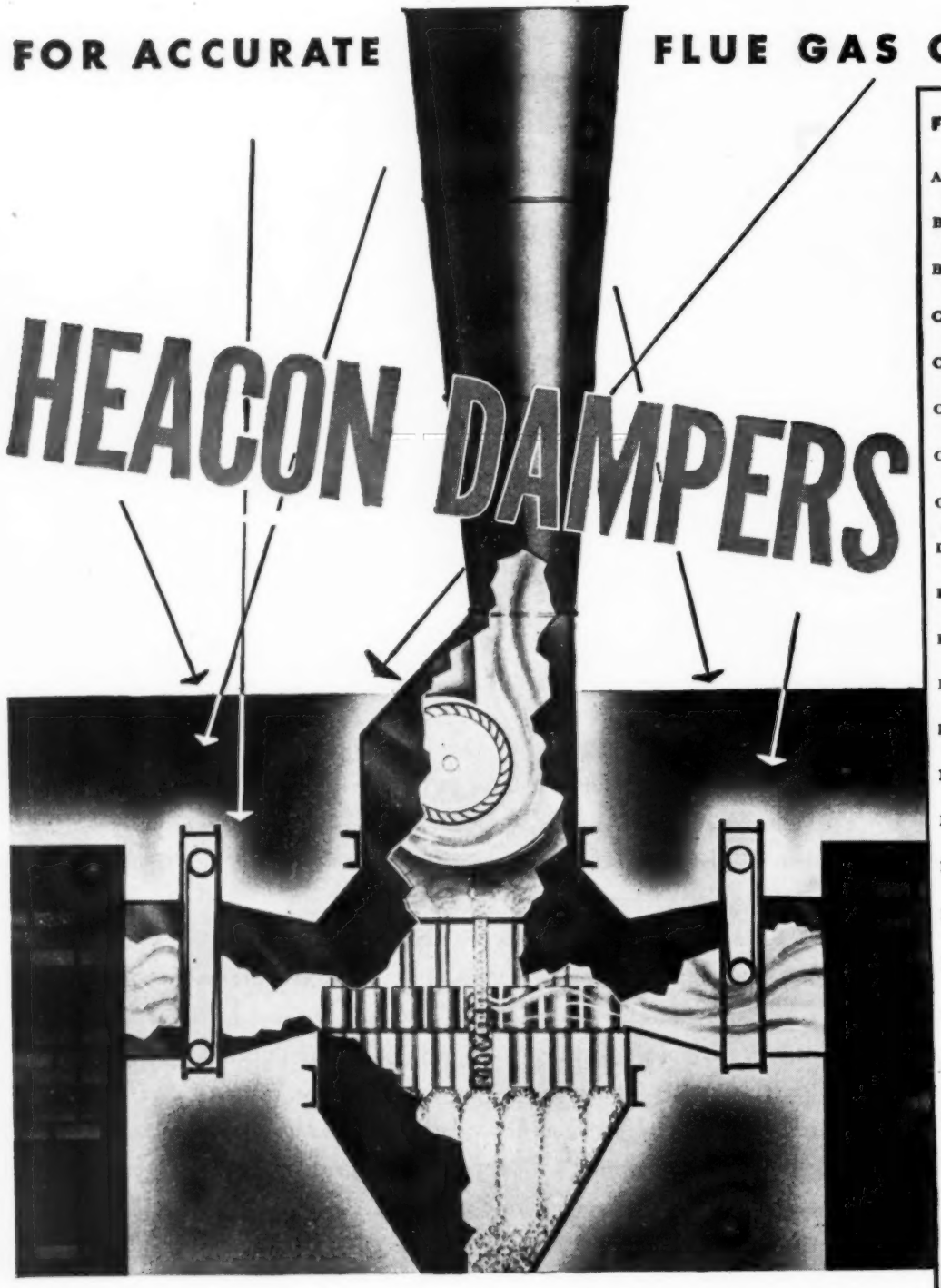

One of the more simple, yet highly important applications of the Heacon Damper is as an uptake damper where two or more boilers are served by one stack.

Illustrated here is a single Type I Thermix stack and Tubular dust collector, serving two boilers, regulated by SVH Type Heacon Dampers.

Heacon Damper tightness results in fuel savings during banking hours, reduction of temperature strain, shortened outage time for maintenance and improvement in automatic draft regulation. These are only a few of the advantages gained from such an installation.

The secret of Heacon Damper tightness is its flexible curtain held firmly against seals on the damper frame by the flow. This construction gives tight shut off without binding and, by the addition of V-porting, permits the accurate control of the smaller increments.

These advantages can mean savings to your plant. Why not call our Field Engineer nearest you? He'll be glad to help you solve your draft control problem.

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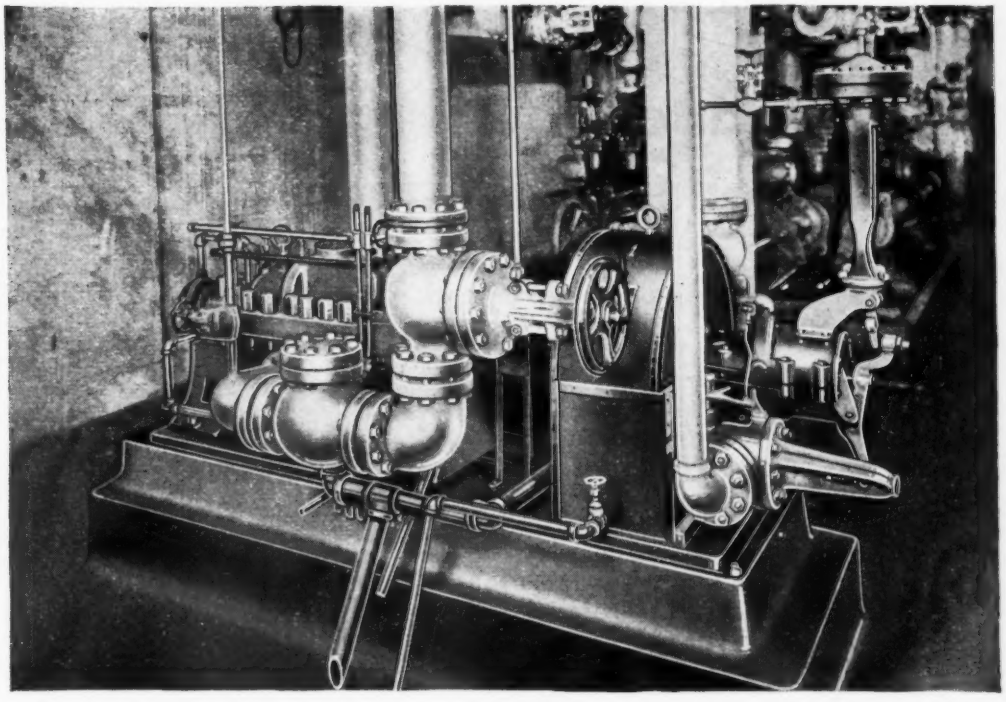


THE BLADES OF THIS BOILER FEED PUMP TURBINE ARE DOUBLE RIM PROTECTED

The 55 H.P. Turbine shown above employs the Terry Solid Wheel Rotor. The wheel is made from a single steel forging and the buckets are milled directly in the wheel.

The buckets are protected by rims at the sides of the wheel as shown in the illustration at the left. These rims would take without damage any rubbing that might occur if the clearance became reduced.

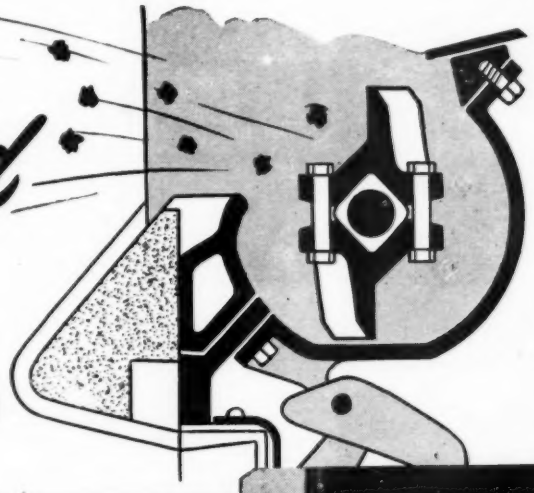
With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

The Terry Wheel Turbine is fully described in our Bulletin S-116.

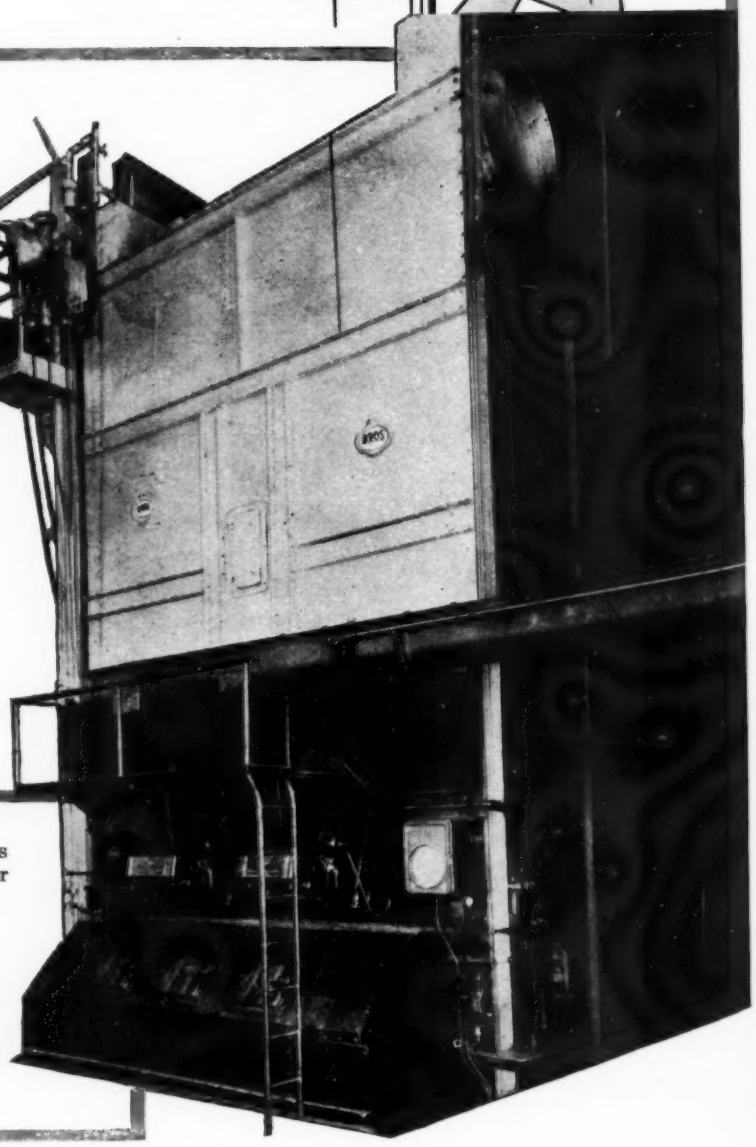
T-1170

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

GET THE ECONOMY OF *Spreader feed* no matter how large the boiler installation



Get the economy of a Bros Travl-Spred Stoker with spreader feed and a traveling grate. A wide range of available fuels . . . easier maintenance . . . low cost operation . . . fast, efficient steam production . . . all these advantages stem from the combination of uniform fuel distribution and continuous ash discharge. Larger installations, formerly beyond practical limits of the spreader stoker and chain grate, can now have all their advantages. In the revolutionary new Travl-Spred Stoker, *Bros* engineers selected tuyere type grates, zoned burning areas and hydraulic drive for a compact unit readily adaptable to new or existing boiler rooms. Find out how *Bros* fits into your steam generating picture.



The Travl-Spred Stoker at the right was recently installed in the municipal power plant at Springfield, Minnesota. The installation includes a *Bros* 3-drum watertube boiler with 35,000 lb. steam, 450 lb. pressure, 750° total steam temperature. The Travl-Spred Stoker uses 14'9" shaft center, two 4' sections in the grate and incorporates two *Bros* Model 24 spreader type stokers.

BROS *Travl-Spred* STOKER

WM. BROS BOILER AND MANUFACTURING COMPANY, MINNEAPOLIS 14, MINNESOTA

FACTORIES
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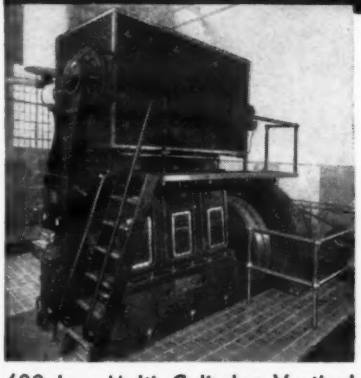
They all get the same answer . . .

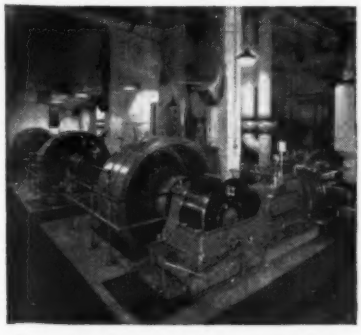
It's Cheaper to Generate Our Own Electric Power

with **SKINNER**

"Universal Unaflow" STEAM ENGINES



600 kw. Multi-Cylinder Vertical "Universal Unaflow" Steam Engine



Three 200 kw. Horizontal "Universal Unaflow" Steam Engines

The economies enjoyed by those who are using Skinner "Universal Unaflow" Steam Engines to generate their own electric power instead of purchasing it are not limited to peculiar situations or to narrow classifications. Skinner Engines are saving money every month for thousands of owners, including hospitals, schools, hotels, office buildings, packing plants, breweries, dairies, laundries, textile mills, potteries, furniture factories, metal working plants, and dozens of others.

The economies of electric power generated on the premises by Skinner Steam Engines are not limited geographically. Owners cover the map from Minnesota to Texas, from New England to California, and dot the rest of the globe.

The economies of generated power are not limited by requirements. Skinner "Universal Unaflow" Engines are built in sizes from 75 to 3000 hp. in horizontal and multi-cylinder vertical types, for direct connection, coupling, or belt drive, to electric generators, compressors, blowers, pumps, lineshafts, or other load.

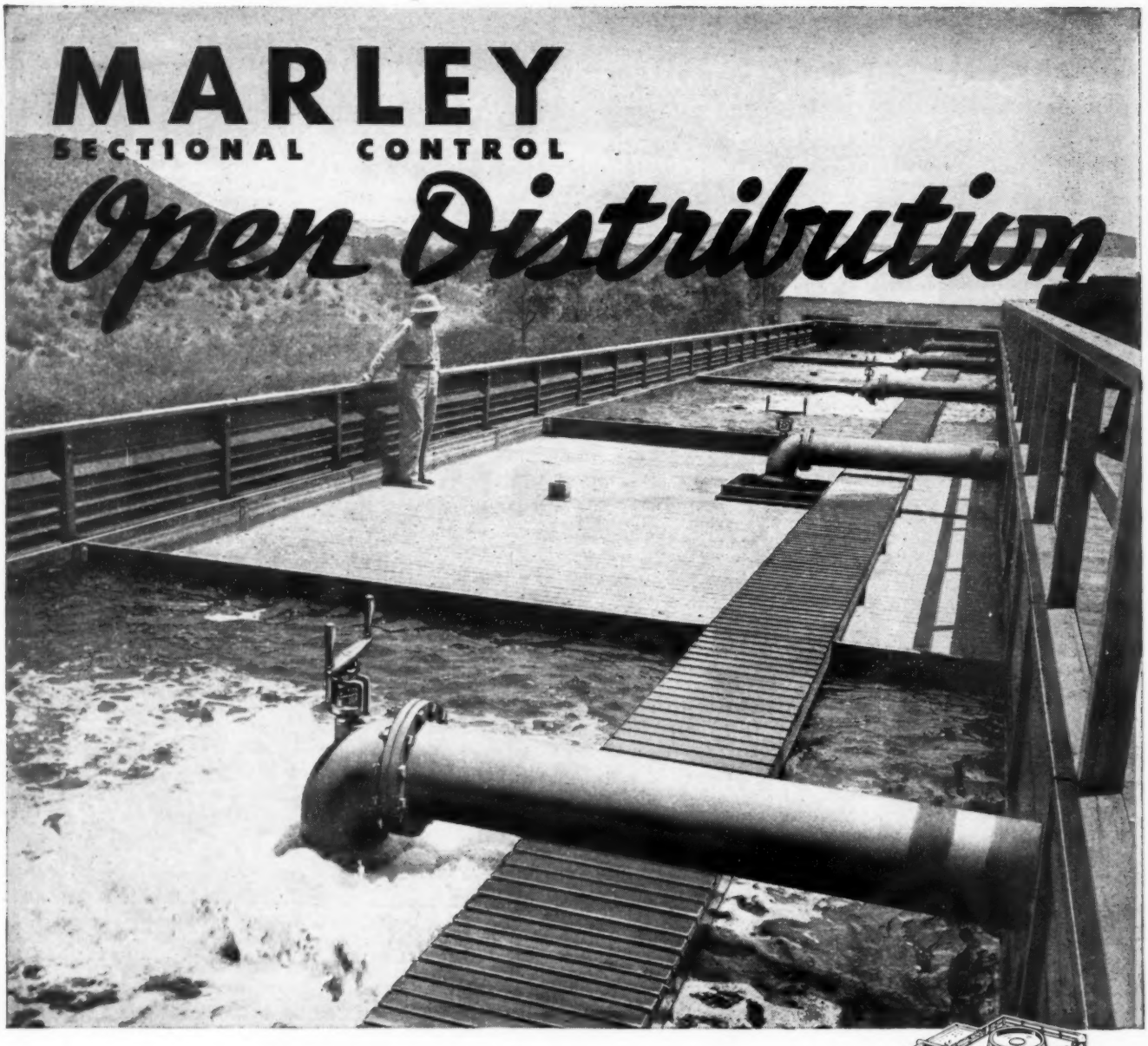
In short, the economies enjoyed by generating power with Skinner Unaflow Steam Engines are limited only by the number of users.

Skinner "Universal Unaflow" Engines are frequently bought under our Guaranteed Savings Contract, payments being made out of proved savings after the engine is in service. Write for detailed information of the advantages of Skinner "Universal Unaflow" Engines in your industry.

For Over 75 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

MARLEY
SECTIONAL CONTROL
Open Distribution



Only **Marley DOUBLE-FLOW TOWERS** *provide exposed, gravity flow distribution with all these advantages:*

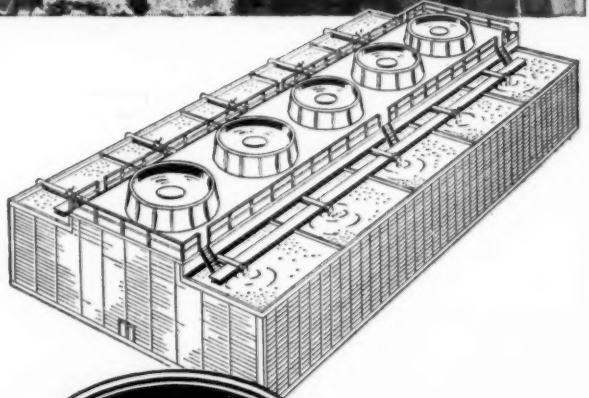
Full Accessibility for inspection or cleaning of any cell or part of any cell—no shut-down.

Eliminates inaccessible small distribution arms or troughs that clog and require replacement.

Operating Flexibility—Water flow readily controlled from full capacity to any desired minimum over each cell.

Adaptability to side or end inlet piping connections at no extra cost.

Lowers Pumping Head by reducing height of water lift and eliminating forced distribution.

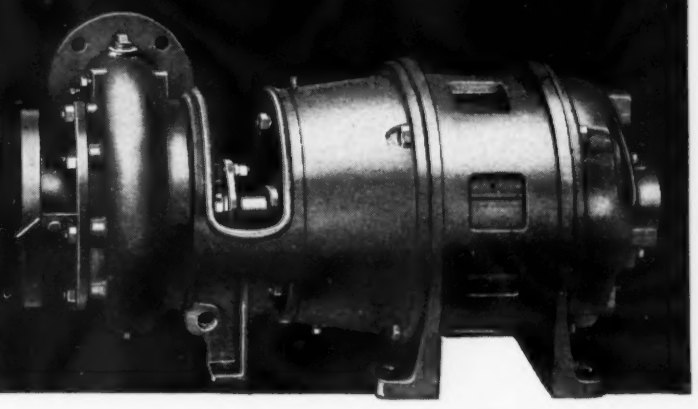


MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

Goulds announces..

NEW "CLOSE-CUPLD" CENTRIFUGAL PUMPS

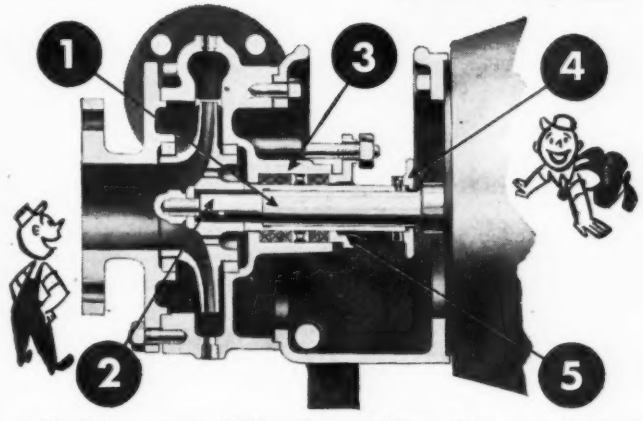


17 sizes... Capacities up to 2000 GPM ...for almost any service!

Drawing upon 100 years of pump design and manufacture, Goulds presents a new line of "Close-Cupld" Centrifugals which give you improved pumping efficiency, simpler maintenance and longer life. Through standardization, wearing parts are interchangeable for pumps of varying sizes. This minimizes spare parts, an important advantage where various size pumps are operating.

Designed for a broad range of service, the field for these new Goulds "Close-Cupld" Pumps is almost unlimited. With heads up to 400 feet, depending on capacities, there is a "Close-Cupld" Pump for almost every condition. Pump and motor are combined in a single, compact assembly, ready to install and operate in any position except vertically with motor below pump.

WHY NEW GOULDS "CLOSE-CUPLD" LAST LONGER



1. Shaft sleeve covers full length of shaft . . . compression seals between shaft sleeve and impeller hub and sleeve and shoulder on shaft completely protects shaft from liquid damage—prolongs life of pump and motor.

2. Unlike most pumps, shaft sleeve is free to expand or contract with temperature changes —prevents buckling and distortion.

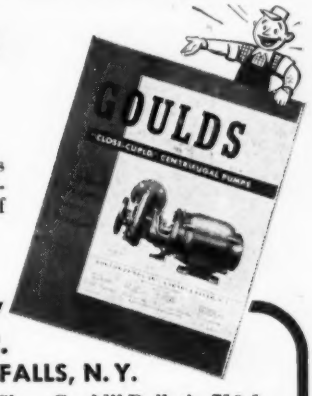
3. Machined stuffing box designed for *die-formed*, semi-metallic packing or mechanical seal without necessity of making changes . . . gives you operating flexibility.

4. Liquid deflector, mounted on end of shaft sleeve, is drilled and tapped so that in servicing pump it can be used to prevent shaft rotation while removing or tightening impeller nut; also, to remove sleeve . . . a time saver.

5. New split gland simplifies repacking of stuffing box, when necessary, another time saver.

GET THIS HELPFUL ENGINEERING BULLETIN!

Contains complete specifications (ASTM designations), full efficiency and horse power ratings of each pump, all dimensions necessary to make a layout. Use coupon below.



GOULDS PUMPS, INC.
DEPT. PO-10, SENECA FALLS, N. Y.

Please send me your new "Close-Cupld" Bulletin 710-1

NAME_____

COMPANY_____

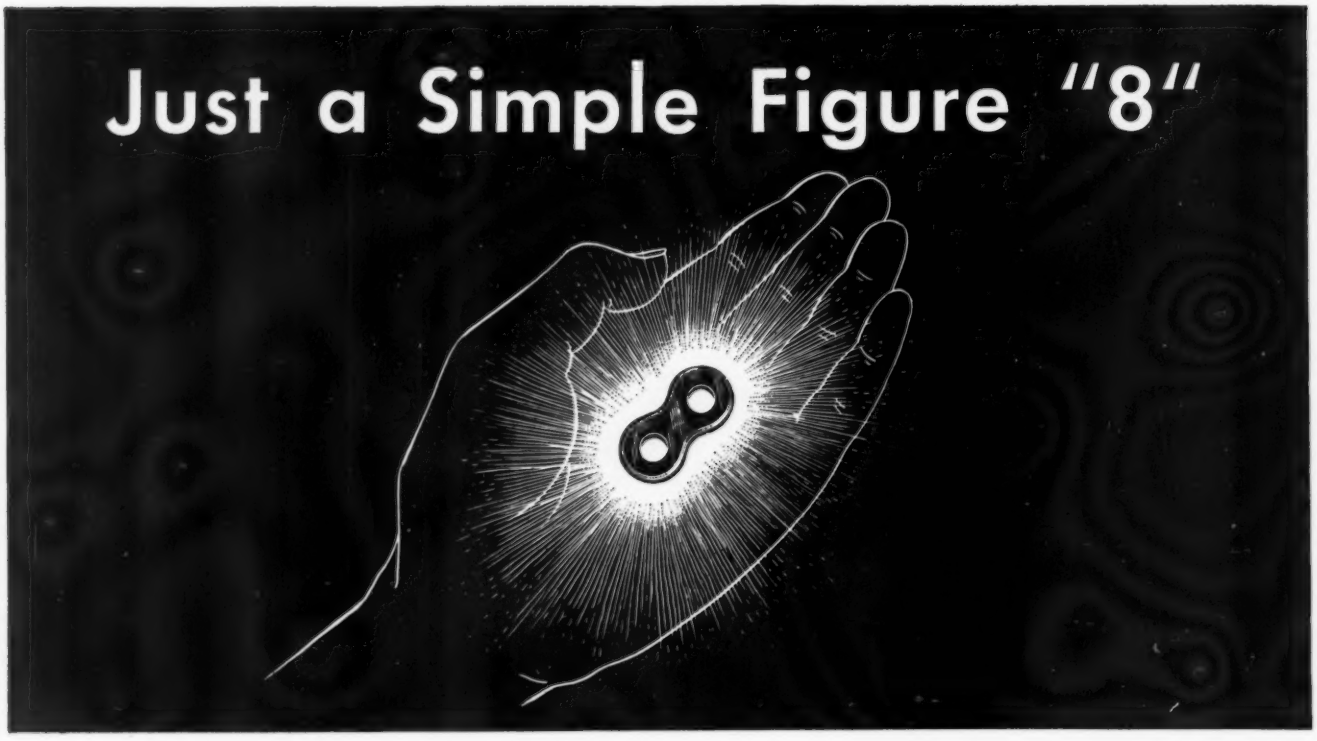
ADDRESS_____

CITY_____ ZONE_____ STATE_____

GOULDS PUMPS, INC.

the PUMP FOR the JOB

Just a Simple Figure "8"



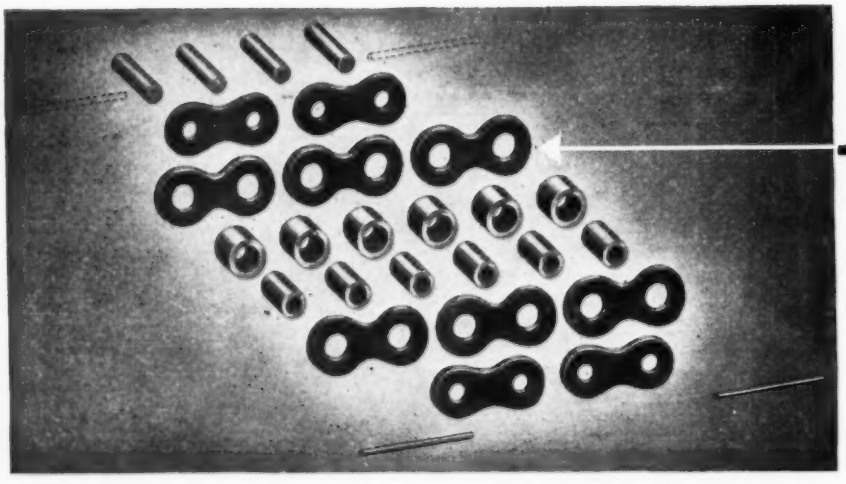
This short length of UNION roller chain is made up of the 28 separate parts shown below.

UNION CHAINS

It's simple enough, true—but for all its simplicity its fabrication requires 12 distinct and precise operations. For this is a sidebar of a pitch of UNION roller chain. If you will look at the "exploded" drawing at the bottom of this page you will see that there are 10 of these sidebars (6 inner and 4 outer) in the short length of UNION roller chain shown at the left. You will also see that there are 28 separate parts in this same length of chain. But what you don't see is that it requires 290 operations to make these 28 parts. Nor can you see that every step from receipt of material to finished product is carefully supervised by an inspection department responsible to the engineering division.

Here at UNION CHAIN we make nothing but sprocket chains, sprockets and attachments. All our skill and effort are concentrated on the precision manufacturing of high quality chains of various types for the transmission of power and the handling of materials. We are not yet able to meet the overwhelming demand for UNION chain, but we assure our customers and friends that we are making every effort to do so, consistent always with the character of our product and the complicated processes of its manufacture.

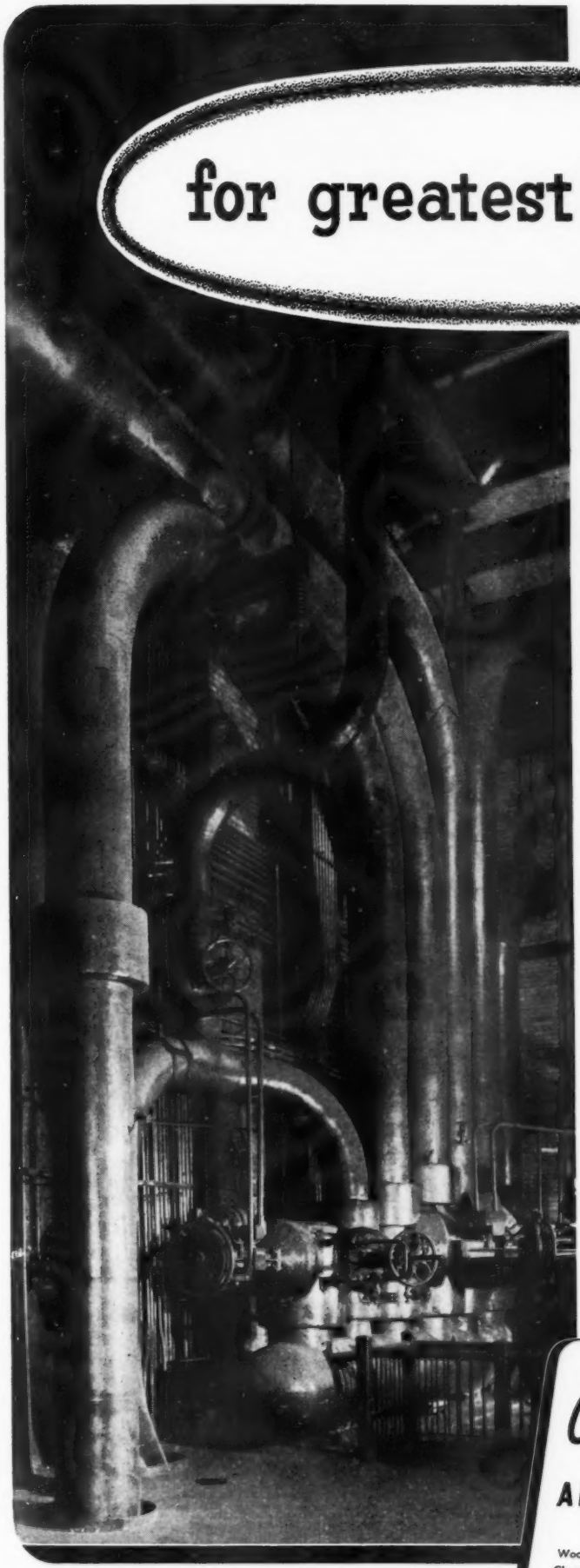
The Union Chain and Manufacturing Company • Sandusky, Ohio

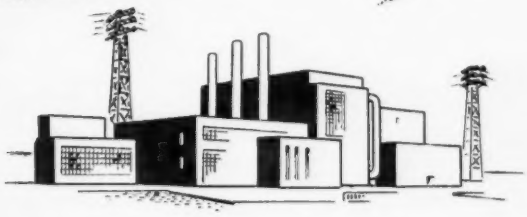


THESE 12 OPERATIONS TO MAKE THIS STEEL SIDEBAR

1. Straighten stock material
2. Pierce pitch holes
3. Blank link contour
4. Coin link edges
5. Stamp name and number
6. Straighten link
7. Broach pitch holes
8. De-grease
9. Heat treat and quench
10. Clean and polish
11. Temper
12. Color

for greatest efficiency...





Entrust Your Complete Piping System Job to Experts

THE fabrication and erection of a lastingly efficient and reliable piping system requires a distinctive engineering technique, specialized manufacturing facilities, broad experience in diversified piping applications, and skill in meeting and solving present-day erection problems.

These requirements are met when you place your complete piping job in the hands of P. P. & E. Our responsibility begins with the blueprint and ends only when the system is in operation.

Sub-assemblies are shop fabricated under ideal conditions, stress-relieved, pressure-tested, checked for dimensional alignment, cleaned and inspected, and shipped ready for accurate assembly. Field erection, which is done by skilled, specially trained craftsmen, is thereby expedited.

By entrusting the complete piping system to P. P. & E. you obtain greatest efficiency—in its manufacture, erection, and operation. There's a P. P. & E. system in your neighborhood. Our nearest representative will give you further information.

Pittsburgh Piping

AND EQUIPMENT COMPANY

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Heights State Bank Bldg., Houston
Whitehead Building, Atlanta

It's heat-treated to make it tougher

This behind-the-scenes view shows you the heat-treating or vulcanizing process that helps put rubber to work for you.

It's one of the many important steps taken to produce Ajax Conveyor Belting—a tough, flexible belt designed to help solve many of your materials handling problems.

You see, this belting is constructed to withstand shock loads of all types of materials. Yet it's so unusually flexible that it naturally forms a trough that holds and carries heavy tonnages of material.

Little wonder, then, that Ajax Conveyor Belting will enable you to speed up your materials handling operations . . . to cut down your production costs!

That's one of the reasons why this belting is so popular in the vast industrial field where it can be used under many varied conditions. It's "Job Engineered" for general conveying service . . . quality-built to lower your belt operating and replacement costs.

Matter of fact, you can use Ajax wherever a long-wearing, dependable belting is needed.

Why not find out how Ajax Conveyor Belting will help improve your operations? For details phone the Hewitt distributor listed in the classified section of your phone directory. Or write Hewitt Rubber Division, 240 Kensington Ave., Buffalo 5, N. Y.

You can depend on your industrial supply specialist

He's always ready to serve you. And he knows your job...your operations...your problems. Call on him at any time for advice. He'll recommend the exact Hewitt product especially designed to help *improve* the efficiency of your operations.

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Ajax Conveyor Belting

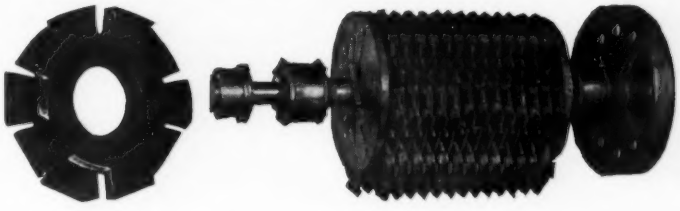
AMERICANS – High Tonnage in Low Headroom

A COMPLETE CRUSHING OPERATION WITHOUT EXTRA PICKING OR STANDBY-CLEANOUT LABOR REQUIRED

The compactness of design and construction of American Type "S" Rolling Ring Crushers make for a complete, high tonnage installation in minimum headroom requirements. ROM coal is rapidly reduced to uniform screenings of stoker or pulverizer sizes. This suits Americans especially well for installation in existing plants without the necessity of extensive alterations.

No auxiliary crushing operations and equipment are necessary to the high performance of Americans — no extra picking and standby-cleanout labor is required.

Americans create no refuse problem. Slates and pyrites are processed and tramp iron rejected. Americans are made in capacities to fit your operation—from 25 to 500 TPH.



American's exclusive manganese steel shredder ring and rotor assembly. The high tonnage output of Americans at slow, power-saving speeds is attained by the rapid reducing action of the multiple cutting edges of the many rows of rings on the heavy rotor.

Each ring revolves on an individual shaft, free to deflect without damage from tramp iron. The crushing chamber of Americans is made up of sectional manganese steel liners. Housings are of heavy ribbed steel castings secured at dust-tight machined joints with coupling bolts for easy access to all crushing parts.

Send for bulletin "Crushing Coal At Less Than 1c Per Ton"

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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Lucky fellows, these East Indian metal workers. Boiler scale, corrosion, and foaming are no concern of theirs, for they use string-and-finger power. Only a blistered digit can cause a drop in power efficiency.

But proper water treatment is essential in plants which use water for steam power . . . or for processing or cooling.

As specialists in their field for over 60 years, Bird-Archer chemists and engineers know how to put the finger on water treatment problems . . . push operating costs down and efficiency up, and add years to the life of water and steam handling equipment.

Bird-Archer offers a complete 8-point service — all or any part of which is available to you. A Bird-Archer representative can furnish full details on how this service can help you. Write and ask to have him pay you a visit.

THE BIRD-ARCHER 8-POINT WATER TREATMENT SERVICE

1. *Study of all available water sources*
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4. *Development of treatment and control system*
5. *Instructing plant staff and furnishing test equipment*
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7. *Specifying automatic equipment if necessary*
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You can depend on B&W pressure tubes to give you the same service satisfaction that has helped millions of dollars' worth of B&W boilers to earn their 80-year reputation for dependable low-cost operation.

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Seamless and Welded Tubular Products in a full range of Carbon, Alloy, and Stainless Steels for All Pressure and Mechanical Applications.

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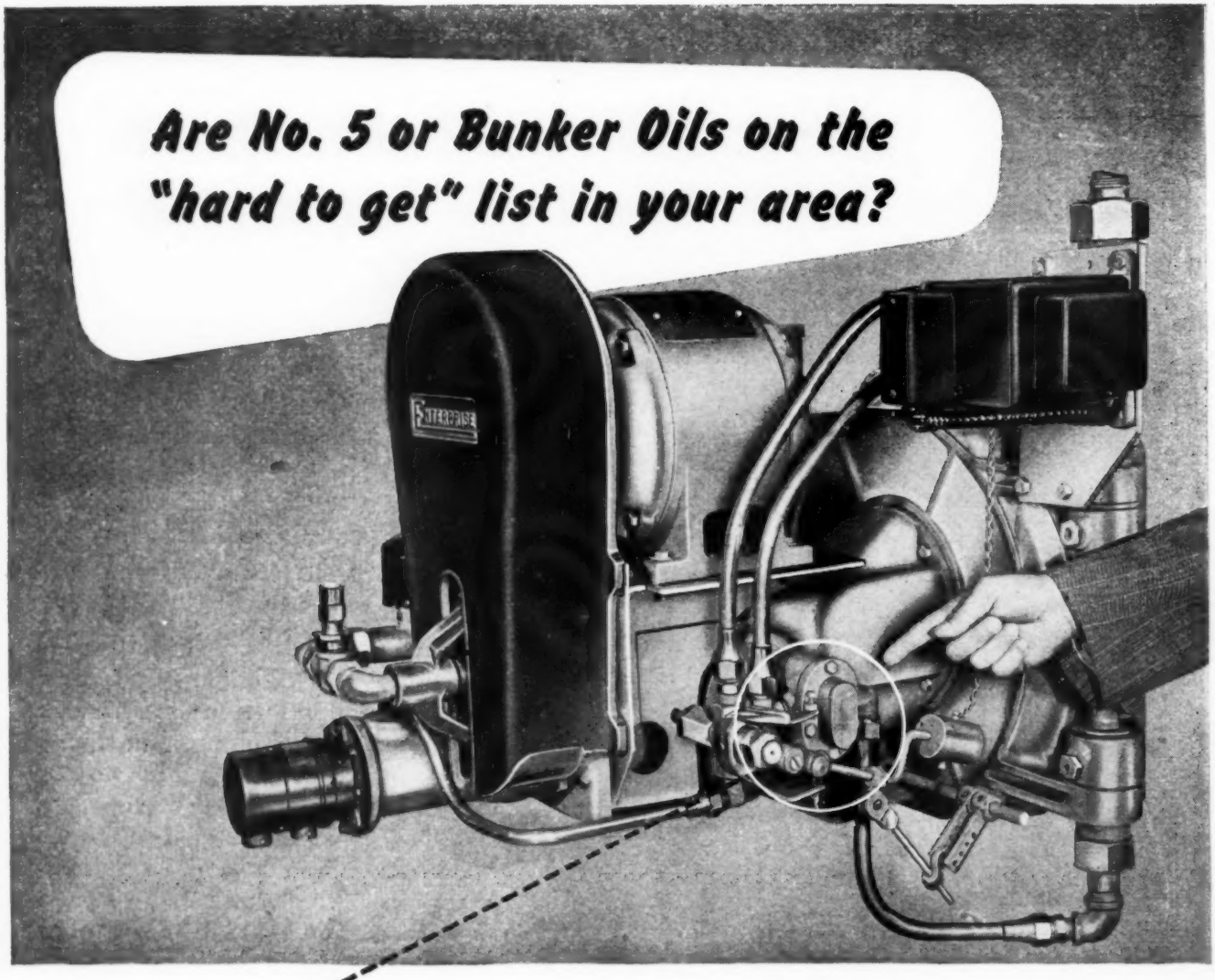

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Economy of operation has always been one of the most important features of Enterprise Oil Burners. That's why they are basically designed to operate on the heavier, less expensive No. 5 or bunker oils. However, where these oils are unobtainable or temporarily unavailable, it's a simple matter to adjust the fuel pump to the efficient use of lighter oils. Today there are many thousands of Enterprise Burner installations in all types of application giving dependable service on the various grades of oil. It's this *flexibility* of fuel use that is putting more and more Enterprise Oil Burners into building and plant specifications. Write today for the full story on Enterprise Oil Burners. *Approved for light oils.*

Enterprise Oil Burners are available in Manual, Semi-Automatic and Fully-Automatic Models in combination with modulating fire control. Combination Gas and Oil Burners are also available.

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ENTERPRISE *Oil Burners*

Presenting

a pictorial record of standard and special built HEAT TRANSFER EQUIPMENT

by **Vogt**

Write for a copy of Bulletin HE-5, on your letterhead.

You are invited to send for this record of ingenuity in heat exchanger design and construction.

Shown, among examples of the many types we build, are units for diversified applications, high pressures, and special operating conditions as well as conventional types for ordinary exchanger services in petroleum refineries, chemical plants, process industries, power plants, etc.

Thousands of installations in successful operation attest to Vogt's ability to give effective help in the solution of heat transfer problems peculiar to a wide variety of operating conditions.

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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Increasing Condenser Tube Life Through Close Cooperation With Bridgeport Laboratory

The desirability of close cooperation between condenser tube users, builders of equipment, consultants and manufacturers of tubing is generally recognized. However, when trying to help the power plant operator obtain more satisfactory service and longer life from his condenser tubing we must work together and pool our experiences and information. The more information available the more satisfactory will be the outcome.

Information Required

Information about operation procedures, composition of the cooling water, temperatures, velocities of water and steam, pressures and other factors is necessary to determine the alloy which will give the longest life under existing conditions. If tubes are failing prematurely a change in operating conditions may be advisable.

Our laboratory is constantly receiving samples of tubing with the object of determining: (1) how condenser tube life can be increased and (2) to learn how certain alloys are standing up under varying conditions of service.

Importance of Proper Sampling

There are many reasons why it is desirable to use full length samples. The primary reason is that the extent of corrosion may vary considerably along the entire length of the tube. Examination of any one spot will not give a true picture. A minimum of two full length tubes should be carefully identified and removed from the condenser or heat exchanger. One tube should be taken from that portion which gives the most trouble and the other from that which gives the least. Otherwise, submit a sample of the worst and the best tube. It is important that the full length sample of tubing be clearly marked to indicate which is the top and bottom as the tubing was used. Also the inlet and outlet ends should be suitably identified. It is necessary to cut the tubing into sections for convenient mailing. We prefer about 2 ft. lengths, with each length numbered consecutively from the inlet end to outlet end so that the tubing may be accurately reassembled in our laboratory.

Pertinent Data

The following information should be furnished with samples properly taken and marked for identification. Most of the information required can be obtained from the records kept by the operating engineer.

1. Length of time sample tube has been in service.
2. History of tube performance in this condenser and adjacent ones.
3. Type of condenser.
4. Temperatures, velocities, and pressure.
5. Elevation of condenser in relation to intake.
6. Operating schedule.
7. Frequency of cleaning and type of debris found.
8. Evidence and nature of pollution, if any.
9. Location of condenser and nature of cooling water.
10. Composition of cooling water.

Water Analysis Important

Experience has shown that the most difficult information to be obtained is a representative water analysis because of seasonal variations. This is further complicated by the fact that the presence of industrial wastes, sewerage, debris, etc. does not appear in the typical water analysis. It is therefore important to know the seasons when the samples for analysis were taken and something about the nature of the pollution, if any. It is well established that the composition of the cooling water has a most important bearing on condenser tube life.

Corrosion Data Available

Bridgeport is maintaining an extensive program of corrosion research, consisting of laboratory work, field and service tests. The purpose of this program is to help users get the most satisfactory service from their condenser and heat exchanger tubes. Our laboratory welcomes the opportunity of cooperating closely with power plant and marine engineers, condenser builders and consulting engineers. Our experience in the field of corrosion is available through the nearest Bridgeport office.

Condenser Tube Manual

Write for your copy of Bridgeport's 112-page Condenser Tube Manual containing up-to-date information about condenser tubes, methods of installing, and complete information about increasing condenser tube life.

Tubing an 8000 sq. ft. surface condenser. Courtesy: Allis-Chalmers Mfg. Co.

Back Issues Available

We will be glad to send you back issues of the Marine & Power Edition of the Copper Alloy Bulletin. You can keep a file of these articles, which contain important information about condenser and heat exchanger tubing, corrosion research, tube installation, and methods for securing longer tube life. Just write to our Main Office at 30 Grand Street, Bridgeport 2, Conn., if you wish to be put on our mailing list.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

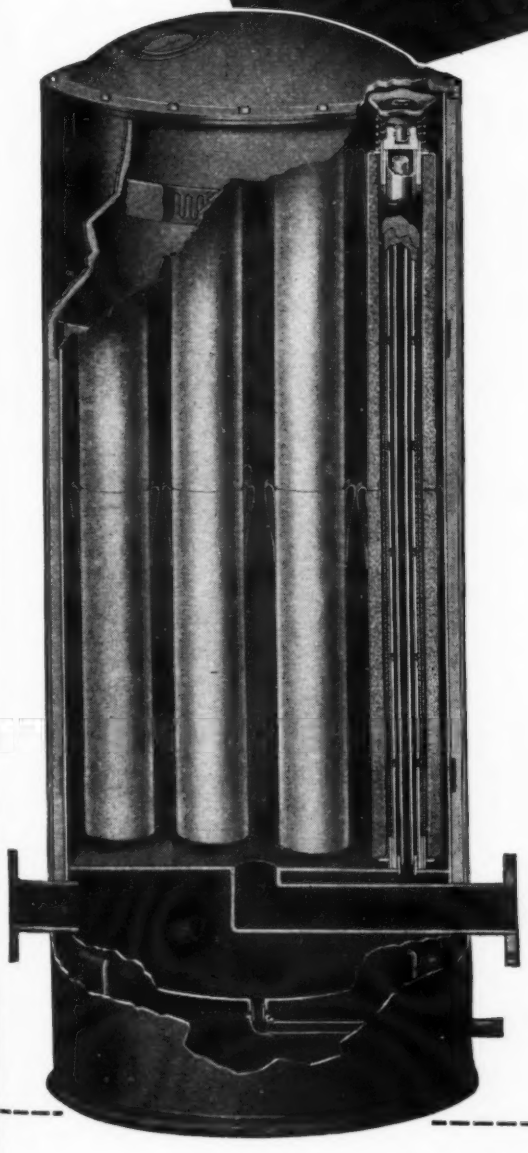
Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

MAYBE IT'S

HONAN-CRANE

OIL PURIFICATION

YOU NEED—



. . . there IS a Difference!

HONAN-CRANE Oil Purifiers give you that "extra" degree of purification not attained with ordinary filters or centrifuges. Purification versus filtration spells the difference in results that points the way to superior engine efficiency and rock-bottom maintenance costs.

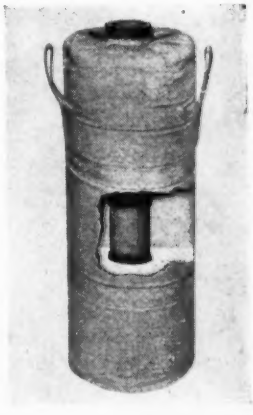
In every case where oil purification has been chosen on the basis of performance under actual operating tests, HONAN-CRANE Oil Purifiers have proved superior—in degree of purification—and in economy of operation.

Why superior? . . . Because HONAN-CRANE Oil Purifiers are performance-engineered from a full knowledge of the problems posed by the many types of engines and equipment using fuel and lubricating oils.

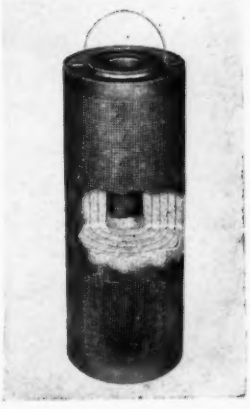
Therefore, to maintain your oils in the best possible condition, you need oil purification equipment engineered to your specific job. You need equipment which is economical to operate, compact in form and simple to install. In short—you need HONAN-CRANE.

May we send you full details on HONAN-CRANE Oil Purification equipment, engineering bulletins and case histories on typical installations? Fill out and mail the coupon.

For Straight Mineral Oils and diesel fuel oils, Honan-Crane Purifiers employ Cranite (specially processed fullers earth) as a purifying medium. The adsorbent material not only removes all abrasives and solids—but goes further to inhibit the auto-oxidation of oil by removal of acids, resins, asphaltines and metallic soaps. These oxidation products form sludges, varnishes, gums, and lacquers which impede lubrication, reduce engine efficiency and hasten wear on bearings, rings and cylinder walls.



For Detergent Oils, Honan-Crane Purifiers are furnished with cellulose fibre cartridges (inter-changeable with the standard Cranite cartridges) hydraulically packed to insure uniform density. Special cellulose fibres are blended by a garnetting process—producing a homogenous filtering maze which insures maximum sediment capacity (longer refill life) and more efficient filtering. The special fibrous medium readily removes particles on the order of a few microns (1 micron equals .000039").



HONAN-CRANE CORPORATION

1200 SIXTH STREET, LEBANON, INDIANA

☐ Please send complete information on HONAN-CRANE Purification of Diesel oils ☐ Please have Sales Engineer call

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COMPANY .....

STREET ..... ZONE .....

CITY ..... STATE .....

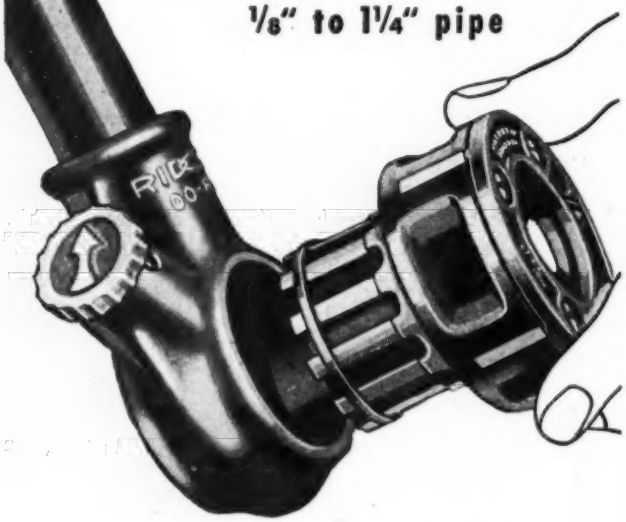
.....

A SUBSIDIARY OF HOUDAILLE-HERSHEY CORPORATION

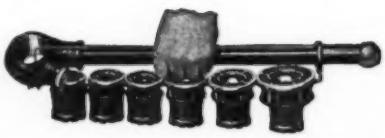
Easy Speed

WHEN YOU THREAD SMALL PIPE

RIDGID Nos. OOR and IIIR make short work of threading 1/8" to 1¼" pipe



Free handy carrier for any group of sizes.



● Ready to cut smooth perfect threads in a jiffy—just snap the size die head you want into the ratchet ring from either side; can't fall out. No special dies needed for close-to-wall threads. Rugged steel-and-malleable construction, long service heat-treated tool-steel dies. No. 00R, 1/8" to 1"; No. 111R, 1/8" to 1 ¼." Save time and work—buy these smart handy tools at your Supply House.

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY · ELYRIA, OHIO

HOPPES

FEEDWATER HEATERS

Deaerating and Non-Deaerating

Write for Bulletin

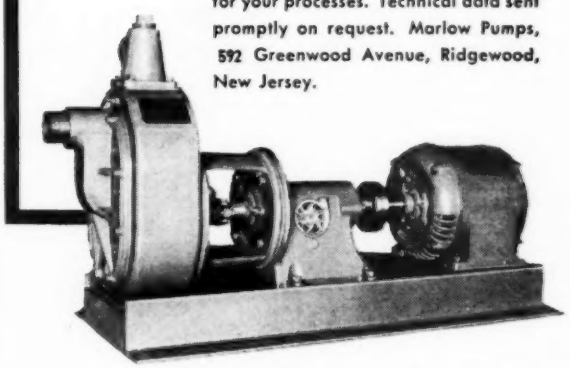
The Hoppes Mfg. Co., Inc.

Established 1881

SPRINGFIELD OHIO

THIS CENTRIFUGAL PUMP LIFTS HIGH PRIMES ITSELF

Marlow Self-Priming Centrifugals prime *automatically* on suction lifts as high as 25 feet. Handle water, coolants, chemical solutions, volatile fluids, liquids containing abrasives, liquids with viscosities to 500 S.S.U. Do not vapor-lock. 1½ to 10-inch sizes; 15 to 3500 GPM. Investigate Marlow pumps for your processes. Technical data sent promptly on request. Marlow Pumps, 592 Greenwood Avenue, Ridgewood, New Jersey.



MARLOW PUMPS

Manufacturers of Quality Pumps Since 1924

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There, right in your office, you will find up-to-date, useful and comprehensive information on forms, characteristics, performance and use of a wide range of materials, equipments and services.

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Sweet's is always working to build a bigger and better file of manufacturers' catalogs so that buyers and sellers can get together faster and at lower cost. If you would like other manufacturers to include catalogs on their products in your Sweet's File, please send us their names.

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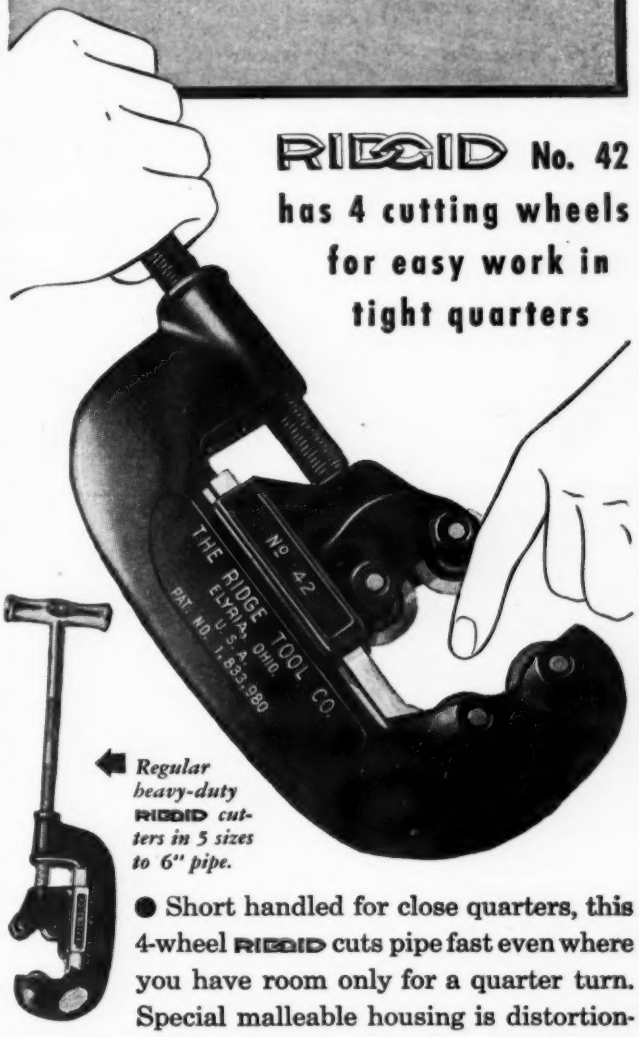
Sweet's Catalog Service
Distribution Dept.
119 West 40 St., New York 18, N. Y.

Free to qualified organizations and individuals

S

Fast Action
PIPE CUTTING
IN TIGHT PLACES

RIDGID No. 42
has 4 cutting wheels
for easy work in
tight quarters



Regular heavy-duty RIDGID *cutters in 5 sizes to 6" pipe.*

● Short handled for close quarters, this 4-wheel RIDGID cuts pipe fast even where you have room only for a quarter turn. Special malleable housing is distortion-proof; heavy-duty cutter wheels roll easily through toughest pipe—always cut true, leave practically no burr. You'll like this efficient work-saver. Ask for RIDGID No. 42 (1/2" to 2") or No. 44 (2 1/2" to 4") at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

BURGESS SNUBBERS · BURGESS SNUBBERS

How to be sure of a quiet exhaust

There is no substitute for good exhaust system control if you are to have a quiet exhaust free of noise complaints.

To be sure of a quiet exhaust, use a Burgess Exhaust Snubber. It provides the freedom from noise required by every engine operating near workers or residences. The exclusive Burgess snubbing principle provides complete noise control, preventing noise before it occurs. Explosive "slugs" of exhaust gas are sent smoothly into the atmosphere, their energies dissipated within the multi-chambered Snubber.

Burgess Snubbers are available for every size and type of Diesel engine. Write today for detailed information.

BURGESS-MANNING COMPANY

749-J EAST PARK AVE., LIBERTYVILLE, ILLINOIS

BURGESS SNUBBERS · BURGESS SNUBBERS

FIGHT RUST with RUST-OLEUM

...the modern rust preventative

$6,000,000,000 is the nation's yearly bill for rust damage to metal caused by dampness, fumes, weathering, etc., *an irrecoverable loss.* You pay your share if your property — buildings, equipment, structures — are rusting. *Do something about it now!*

Rust-Oleum's enduring protective coating seals metal against rust-forming elements. It can be applied directly over rusted metal after quick, simple preparation. Rust-Oleum cuts maintenance costs 3 ways: 1. *Requires less preparation time.* 2. *Goes on faster.* 3. *Protects longer.*

GET THE FACTS...MAIL THIS COUPON TODAY

RUST-OLEUM CORPORATION

2447 Oakton Street • Evanston, Illinois

Send free copy of new Rust-Oleum Catalog with color selections and recommended uses.

*Name*_____

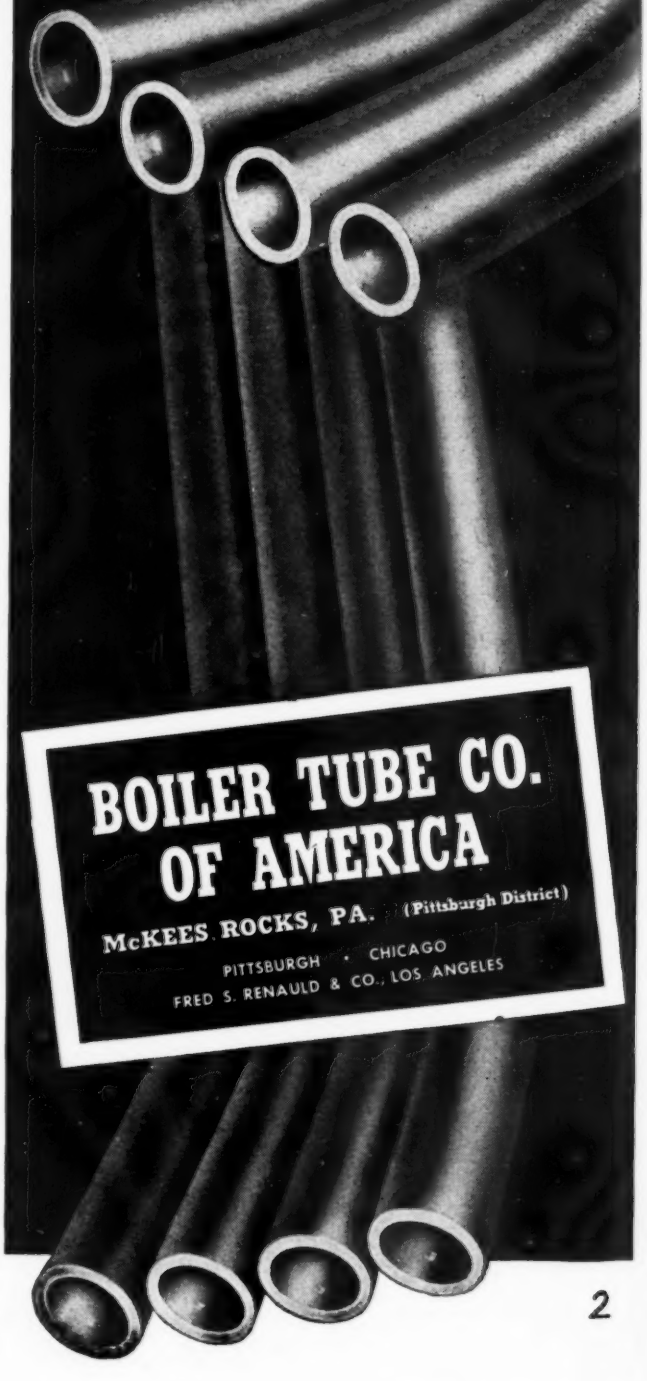
*Company*_____

*Address*_____

*Town*_____ *State*_____

The World's Fastest

complete boiler tube service!



BOILER TUBE CO. OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District)

PITTSBURGH • CHICAGO

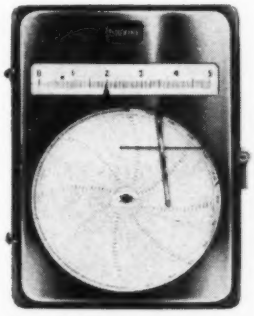
FRED S. RENAULD & CO., LOS ANGELES

2

Which of these

BROOKE SMOKE INDICATORS

Best Fit Your Needs?



RECORDER (TYPE B)

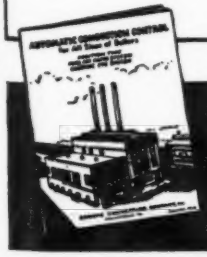
One of two types. Gives continuous record of degree of smoke density. Type A shows length of time red or amber light is lit.

OVERFIRE JET CONTROL

Used to start-stop overfire jets on coal fired boilers. Rugged—suitable for the most severe boiler room operation.

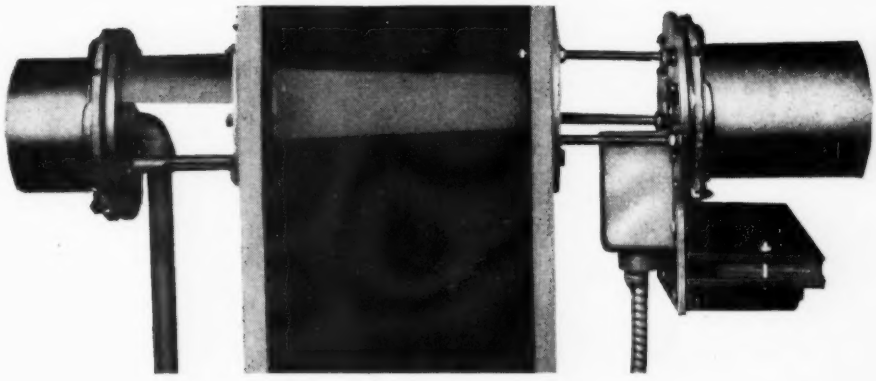
PERISCOPE SMOKE INDICATOR

Another type of Brooke indicator having (1) Unbreakable stainless steel mirror (2) Pyrex glass at breeching (3) Dust-tight sealed light source and mirror box. (4) Heavy cast aluminum throughout. (Bulletin 18).



There's a type for your individual requirements

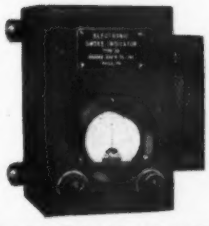
. . . having this Electric Eye Feature . . .



. . . *and these Exclusive Advantages!*

1. **Light Source and Eye Box all aluminum construction completely dust tight.**
2. **Sealed lens and gasketed covers.**
3. **Tripod support on light source for adjusting light beam direction.**
4. **Built-in voltage regulator for precision indication.**
5. **No relays, open contacts, or moving parts . . . all Electronic!**

TYPE ED FLUSH



TYPE ED SURFACE MOUNTED

ADDITIONAL FEATURES

1. **Extreme Rugged Construction.**
2. **Complete with breeching mounting flanges**
3. **Warning lights adjustable to any degree of smoking density.**

All these advantages of Brooke Smoke Indicators are included in the wide variety of models designed to meet the varying needs of power plants, large and small.

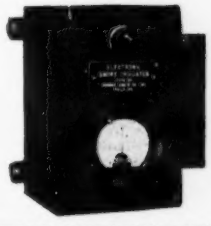
Illustrated above is the eye box and light source mounted at the breeching.

Type EC has one red warning light indicating smoke.

Type ED has an additional light (amber) indicating clear stack.

We invite you to write today for Bulletin #20 describing in detail Brooke Smoke Indicators.

TYPE EC FLUSH

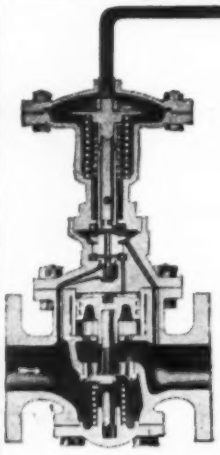


TYPE EC SURFACE MOUNTED

BROOKE ENGINEERING CO., INC.

4517 Wayne Avenue · Philadelphia, Pa.

MANUFACTURERS OF THE FIRST SUCCESSFUL ELECTRIC EYE SYSTEM OF COMBUSTION CONTROL



LESLIE

CLASS LT-3
REMOTELY ADJUSTED
REDUCING VALVE
with
AIR LOADING PANEL

An ideal combination for Steam Heating Systems where valves are inaccessible for re-adjustments. Avoids wasteful overheating. Saves time and eliminates safety hazards.

Write for Bulletin 461

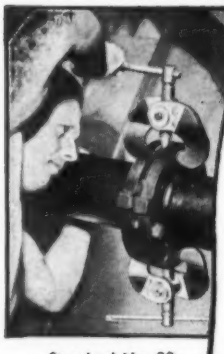
CLASS LT-3
REDUCING VALVE

TYPE ARP
Air Loading Panel

LESLIE CO.
255 Grant Avenue, Lyndhurst, N. J.

ESTABLISHED 1900
LESLIE CO.

PRESSURE-REDUCING VALVES · PRESSURE CONTROLLERS
PUMP GOVERNORS · TEMPERATURE REGULATORS
SELF CLEANING STRAINERS · LESLIE-TYFON WHISTLES



REPLACE GASKETS QUICKLY . . . EASILY

Williams FLANGE-JACKS, formerly manufactured by T. J. Persson Co., Bloomfield, N. J., eliminate long, costly shut-downs for gasket replacements. Ease of operation permits speedy separation of flanges regardless of location. Operating with a minimum of effort even in tight, cramped quarters, FLANGE-JACKS exert tremendous pressure evenly and smoothly . . . without shock along the pipe line. Bolt holes are securely held in perfect alignment and flange faces cannot be damaged. See your distributor for trade discounts on these fully patented tools.

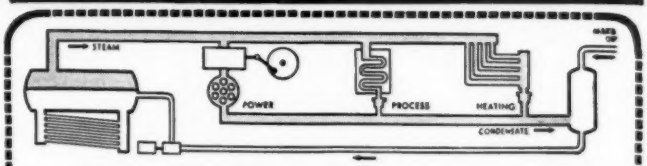
Standard No. 20
$24.00 pr.
Giant No. 30
$48.00 pr.

J. H. WILLIAMS & CO.
BUFFALO 7, N. Y.

SOLD IN PAIRS

WILLIAMS
Flange-Jacks

Put CORAVOL in your STEAM SYSTEM



The CORAVOL-ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

and stop Corrosion!

CORAVOL SAVES you costly pipe repairs, replacements, maintenance labor, hours and days of shutdown loss.

CORAVOL in your steam system (1) prevents corrosion in steam and condensate lines, (2) cleans out clogging rust deposits resulting from previous corrosion. Thus, CORAVOL *protects lines;* increases effectiveness of heat transfer surfaces; restores original capacity of lines and the operating efficiency of valves and traps.

CORAVOL is *not* a boiler feed water treatment — it is designed expressly for use in steam systems. Because CORAVOL volatilizes and condenses with the steam, it circulates throughout your entire steam system and protects *all* zones from corrosive attack.

The use of CORAVOL *in steam systems is covered by U. S. patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile amines purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.*

WRITE TODAY for complete FREE data about the CORAVOL process.

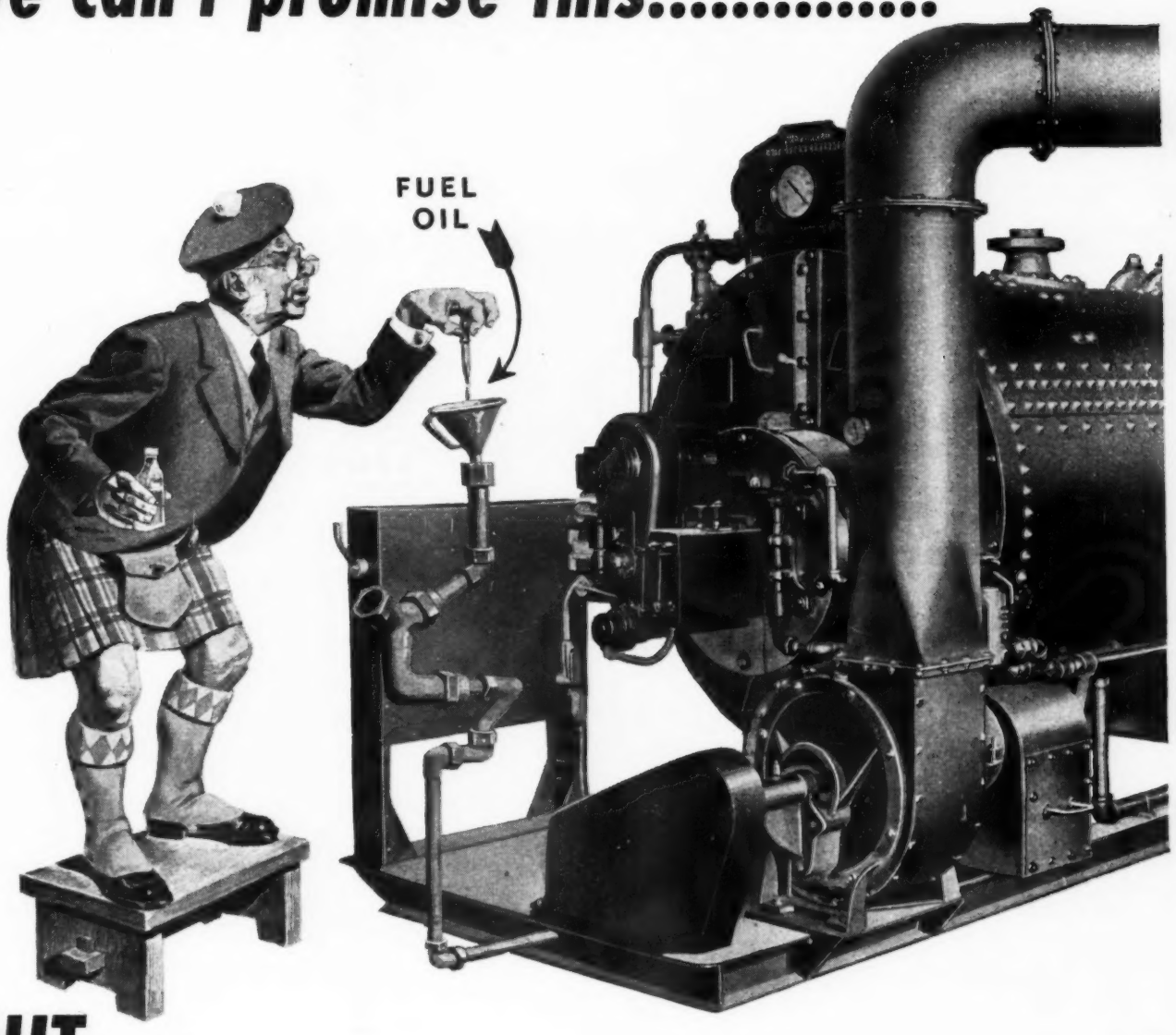
CORAVOL is part of a complete technical service which provides special formulas of treatment for:

Boiler Feed Water . . . Hot Water Supply . . . Refrigerating Brine . . . Cooling and Condenser Water . . . Rapid Scale Removal . . . Coagulation . . . Algae Control.

57 Years of Experience in the Chemical Treatment of Water

WESTERN CHEMICAL CO.
713 WASHINGTON KANSAS CITY, MO.

We can't promise this.....



BUT.....

PR-152

We *can* promise that — compared to many old boilers — a modern Preferred Unit seems to consume fuel in "medicine-dropper doses". Savings on fuel of as much as 50% have frequently been realized by replacing a boiler, in use for 15 years or more, with an up-to-the-minute Preferred complete steam generating plant.

Just flip the switch and your Preferred Unit Steam Generator starts generating steam rapidly and economically. Operation is fully automatic — in *all* sizes — with *all* grades of fuel oil. 80% minimum thermal efficiency is guaranteed.

Other special Preferred features insure the utmost in fuel economy:

- Four long, steam-making, downdraft, gas passes provide maximum heat absorption.
- Induced draft fan guarantees a constantly correct air supply under all barometric conditions — no expensive stack is necessary.
- The exclusive Preferred Horizontal Rotary Oil Burner—designed and manufactured for Preferred combustion chambers — assures perfect combustion at all times.

And a complete range of sizes from 10 to 500 H.P. means that you get the unit suited to your specific steam requirements. No need to buy a larger capacity than is necessary . . . or to use two small boilers in place of one large unit.

You will find money-saving facts in two booklets which give the inside story of Preferred steam generation. "Dividends From Your Power Plant" explains the profit side of the story for management's benefit . . . Bulletin 1000-E puts it into engineering language for the plant engineer. Send for your FREE copies today.

P-10-47

PREFERRED UTILITIES MANUFACTURING CORPORATION, 1860 Broadway, New York 23, N. Y.

PREFERRED UTILITIES MFG. CORP.

PREFERRED UTILITIES Rigged for Results ENGINEERED

Use
THE GENUINE Squires

REDUCING VALVES

for dead-end service, or wherever close regulation is required.

Also Steam and Air Traps, Pump Governors and Boiler Feed Water Controllers.

THE C. E. SQUIRES CO.

E. 40th St. and Kelley Ave. Cleveland, O.

Hi-Pressure Gage Glasses

Round, Tubular and Flat Type

Fig. 12

RUBBER GAGE GLASS GASKETS

Series 750 . . . All Sizes

Fig. 21 Fig. 22

Other Ernst Specialties

are given in Catalog No. 48 P

GAGE GLASS ILLUMINATORS
NEW PLASTIC GUARDS
SIGHT FLOW INDICATORS
SPLIT-GLAND WATER GAGE
STEEL GAGE VALVES
FLAT GLASS INSERTS
ALL IRON GAGES
HIGH & LOW ALARM COLUMNS
MICA SHIELDS AND GASKETS
AND OTHER HELPFUL TIPS ON BOILER ROOM SAFETY

Inclined for Better Visibility

Standard Type—Offset Adjustable Inclined Gage Fittings

Fig. 47

Fig. 13

Leakless Super Try Cocks, Bronze and Forged Steel Construction

Send for Catalog 48P

Ernst WATER COLUMN & GAGE CO.

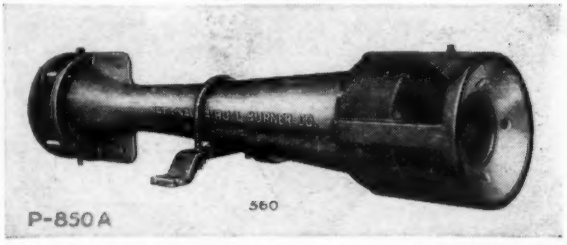
LIVINGSTON, N. J. LIVINGSTON 6-1400

NATIONAL AIROIL FUEL OIL - GAS BURNERS

"AIROCOOL"

GAS BURNER NOZZLES

PATENTED

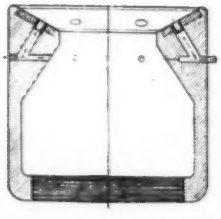


PREVENT OVER-HEATING AND BURNING OF CASTINGS . . .

and insure stable ignition over a long, trouble-free life. Renewable type recessed gas tips direct the separate igniter flames against the main volume of the mixture to insure stable ignition . . . and allow greater turndown without burnback.

Recessed facing of refractory insulating plastic protects nozzle from extreme heat and prolongs nozzle life.

For detailed information about these long-life nozzles, write for Supplement 3 to Bulletin 55.



NATIONAL AIROIL BURNER CO., INC.

Main Offices & Factory: 1250 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.
Texas Office: 2nd National Bank Bldg., Houston

Coal bunkers give longer service when armored with LUMNITE concrete

CORROSIVE action of sulphur compounds leached from coal is easily checked with rugged bunker linings of LUMNITE concrete. In close contact with the steel, the dense concrete prevents corrosive water from working in behind the lining and attacking the steel.

LUMNITE is a special hydraulic cement of the calcium-aluminate type and is not a portland cement. A structural cement for rapid construction, it is used with selected aggregates to make corrosion-resistant concrete.

Tough, dense LUMNITE concrete resists abrasive wear. Monolithic, one-piece construction does away with joints which may roughen up, tear out, cause leakage and expose the steel to corrosion.

Installation is easy. The LUMNITE lining can be shot on with a cement gun, plastered by hand or cast in place to exact form required, regardless of curves, corners and angles.

Write for further information on coal bunker linings as well as other uses of LUMNITE in power plants. Also, ask for new booklet "Concrete Linings in Steel Stacks."

Lumnite Division

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

135 EAST 42nd STREET • NEW YORK 17, N. Y.

Positive Vapor Control with BS & B VENT VALVES

B S & B Vent Valves offer positive protection against excessive vapor loss when storing petroleum products. Overpressure lifts cover, allowing vapors to escape. Excessive vacuum lifts valve gasket, permitting in-breathing until normal pressure is restored.

Specifications to fit your venting requirements: Sizes 2" to 24"; Standard opening pressures, 3 to 1½ oz.; Maximum opening pressures, 16 to 4 oz.; Standard opening vacuum, ½ oz. Bodies, Covers, Gaskets, in wide variety of metals and materials.

Call your nearest B S & B Sales Engineer today! Or write to Special Products Division, Black, Sivalls & Bryson, Inc., Power and Light Building, Kansas City 6, Missouri.

SPECIFICATIONS

Model Number	Size, Inches	Standard Opening Pressure, Ounces	Maximum Opening Pressure, Ounces	Standard Opening Vacuum, Ounces
2VVH	2	3	16	½
3VVH	3	3	16	½
4VVH	4	2	16	½
6VVH	6	2	16	½
8VVH	8	2	16	½
10VVH	10	2	16	½
12VVH	12	2	10	½
16VVH	16	2	8	½
20VVH	20	2	6	½
24VVH	24	1½	4	½

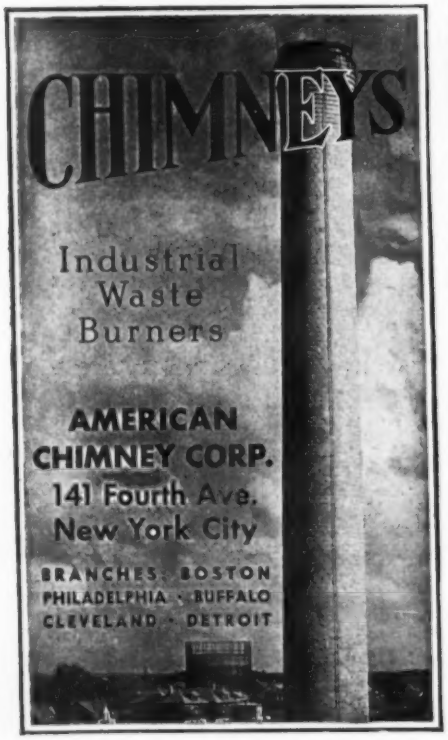
FOREIGN INQUIRIES INVITED — EFFICIENCY — RELIABILITY — Cable Address: BLACK, KANSAS CITY, U.S.A.

BLACK, SIVALLS & BRYSON, INC.

KANSAS CITY, MO. CASPER, WYO. OKLAHOMA CITY, OKLA. CALGARY, ALTA.

WHERE TO BUY

Featuring additional products specialties and services for power plants



MAXIMUM FIRING and COMPRESSION INSTRUMENT

FOR DIESEL AND GAS ENGINES

A hydraulic compression pressure indicator which aids in eliminating trouble and unnecessary repair work for pressure measurements of all pulsating gasses and fluids.

Direct reading, indicates readily the type and location of faulty operation or failure, insures smooth operation by properly balancing cylinder loads.

PRICE $21.25

Send check or money order, or write for descriptive booklet.

METAL SPECIALTIES CO.
P. O. Box 41 Morristown, N. J.

BIRCH
Pump Valves
•
Standard In
RAILROADS, MINES, WATER WORKS INDUSTRIALS

● They Increase efficiency, capacity, economy—decrease slippage, leakage, fuel consumption—will not sink in seat ports, warp, break, curl, or ride seat bridges. For hot or cold water service . . . thoroughly dependable.

BIRCH MANUFACTURING CO.
1521 Sedgwick St., Chicago, Ill.

TEST SPEEDS and SAVE.—At a glance
REVOLUTIONS and FEET per min.
SPEED VARIATIONS
BELT SLIPPAGE
Send for Bulletin

O-Z Improved Hand Tachometer-Cutmeter
O. ZERNICKOW CO.
21 Park Row New York

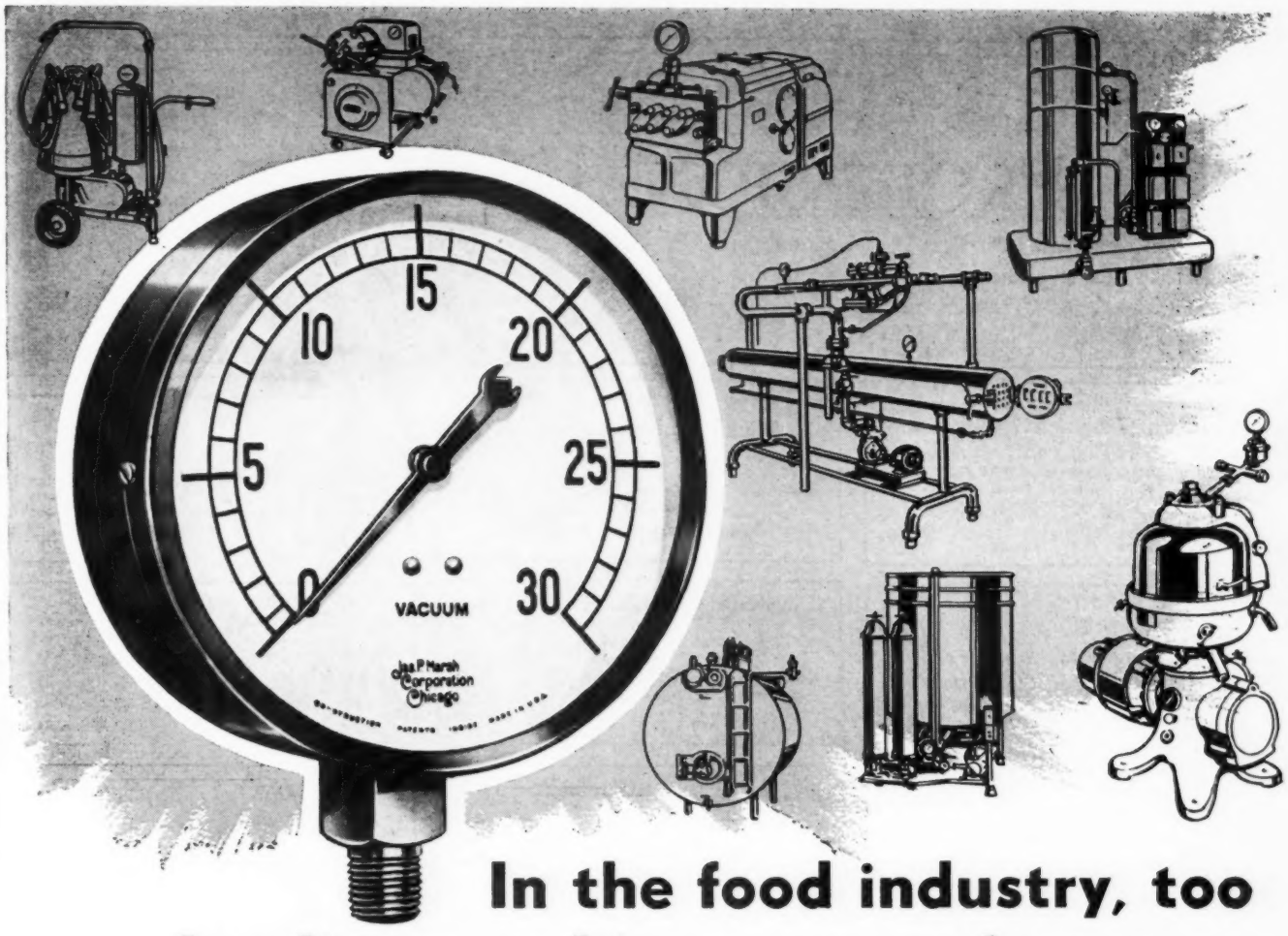
If you don't see what you want . . . ask for it

If you don't see the equipment advertised that you want, ask for it—ask the advertisers—or we will gladly ask them for you.

Classified Advertising Division
POWER

"MONO" BOILER BAFFLES HIGH TEMPERATURE Refractory Cements

SANFORD C. SMITH REFRACTORIES, INC.
1715 NIAGARA ST., BUFFALO, N. Y.



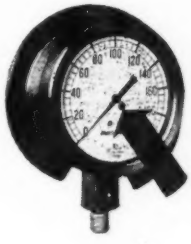
In the food industry, too leading machinery manufacturers rely on *Marsh* . . . .

Manufacturers of milk processing, canning, packing and similar equipment know the vital importance of highly dependable, extremely accurate pressure and vacuum indication. That is why Marsh Gauges are on the preferred list in the food-machinery field . . . are chosen as standard equipment by the largest producer of machinery of this type and by 32 other leading food-equipment manufacturers.

The wide range of conditions found in the highly varied processes of the food industry are a real challenge to pressure gauge quality, so the preference shown by this industry is an impressive tribute to Marsh design and construction. However, it is no more significant than the preference shown by manufacturers in many other fields.

These manufacturers who use gauges as standard equipment have found in Marsh instruments the uncompromising quality that has made them "The Standard of Accuracy." In short, they have found the kind of product they are proud to make part of their own product!

Consider this when you choose a gauge or when you purchase equipment requiring a gauge. Insist on the Gauge that is preferred by the most discriminative users of pressure gauges—MARSH.



MARSH ALONE HAS THE "RECALIBRATOR"

. . . quickest and best way to correct a gauge that has been knocked out of adjustment by improper handling.

JAS. P. MARSH CORPORATION, 2025 Southport Avenue, Chicago 14, Illinois

Export Dept.: 155 E. 44th St., New York 17, N. Y.

Jas. P. Marsh products include: A full line and range of gauges in pressure, compound, altitude, hydraulic, sprinkler, ammonia, ounce-graduated retard, test, and diaphragm types. Dial thermometers in rigid stem and remote reading types. A broad line of steam and hot water heating specialties. *Ask for literature.*

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The specialists whose professional cards appear in this Directory, can answer that question—*are* answering it continually for other power men.

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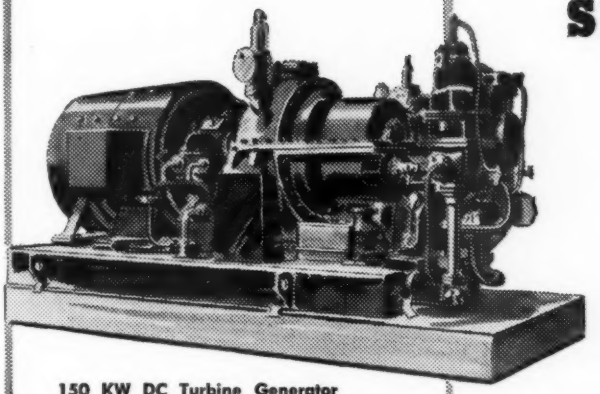
Can Money Be Saved In YOUR Plant?
The specialists, whose professional cards appear in this Directory, can answer that question—and *are* answering it continually for other power men.

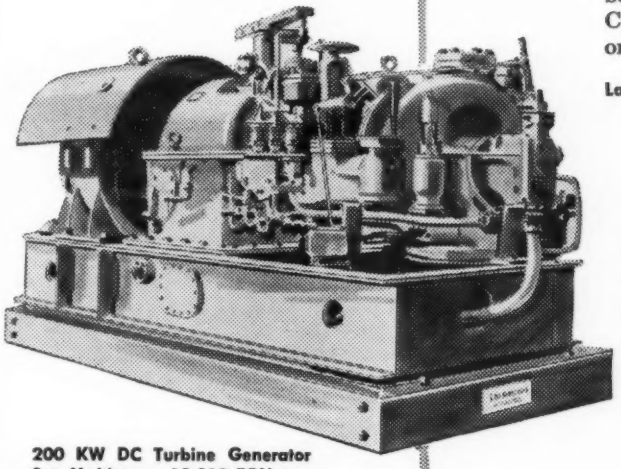
MORE POWER TO YOU

Sealed Bid Sale of...

TURBO-GENERATORS
STEAM TURBINES
ELECTRIC WINDLASSES
SPARE PARTS



150 KW DC Turbine Generator Set. Seven stage, 6583 RPM turbine coupled to single reduction, double helical gear. Generator 1200 RPM. Four sets available.



200 KW DC Turbine Generator Set. Multistage, 10,012 RPM turbine arranged to drive through reduction gear. Four sets available.

Millions of dollars' worth of this equipment, produced by "big-name" manufacturers, is offered in this great Sealed Bid Sale. It includes 12,500 to 50,000 horsepower steam turbines, turbines of the marine propulsion type, and direct-drive generator sets like those illustrated, together with spare parts for the generator sets. Inventories also include various sizes of electric windlasses and their spare parts.

For a complete listing of the equipment being offered, write: Customer Service Center, War Assets Administration, at any one of the following addresses:

Lawrence & Warren Sts.
Helena, Montana

157 South Howard St.
Spokane, Washington

1409 Second Avenue
Seattle, Washington

This sale is being conducted by these Customer Service Centers. Bids will be accepted up to 5 P. M., November 15, 1947. However, you can get your complete listing *now*. Ask for Listing No. SEL-62-42632.

OFFICE OF GENERAL DISPOSAL

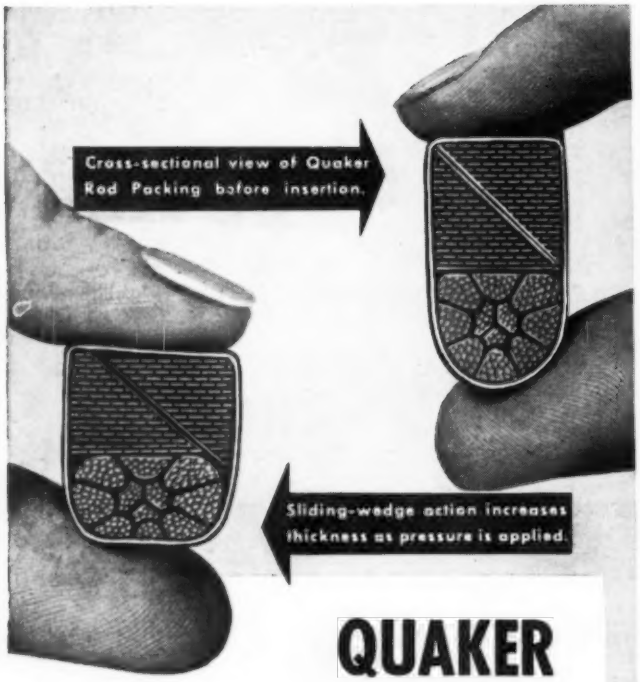
WAR ASSETS ADMINISTRATION

GOVERNMENT SURPLUS WAA

Offices located at: Atlanta • Birmingham • Boston • Charlotte Chicago • Cincinnati • Cleveland • Denver • Detroit • Grand Prairie, Tex. • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock Los Angeles • Louisville • Minneapolis • Nashville • New Orleans • New York • Omaha • Philadelphia • Portland, Ore. • Richmond • Salt Lake City St. Louis • San Antonio • San Francisco • Seattle • Spokane • Tulsa

1348

Customer Service Centers in these and many other cities.


Cross-sectional view of Quaker Rod Packing before insertion.
Sliding-wedge action increases thickness as pressure is applied.

QUAKER P.P.P. ROD PACKING

. . . self-sealing
. . . leak-proof
. . . friction-free

Daniel's P.P.P. Packing, made exclusively by Quaker, provides tight-sealing, low-cost service even under high pressure, due to its sliding-wedge action. Note illustration above—when packing is compressed, the sliding-wedge movement increases its thickness. This applies firm, uniform pressure around piston rod, assuring tight, leak-proof sealing with minimum friction. The higher the working pressure . . . the tighter the seal.

Rigid installation tests made of Daniel's P.P.P. indicate power savings of over $105.00 a year per rod as compared to other types of packing. Expertly-made and carefully lubricated, it's the Perfect Piston Rod Packing. That's why it pays to switch to Quaker for economical packing service for steam, ammonia, water, hydraulic equipment and countless other uses. Call your Quaker Distributor today.

"If there's a way to get it done . . . Quaker will do it"

QUAKER RUBBER CORPORATION

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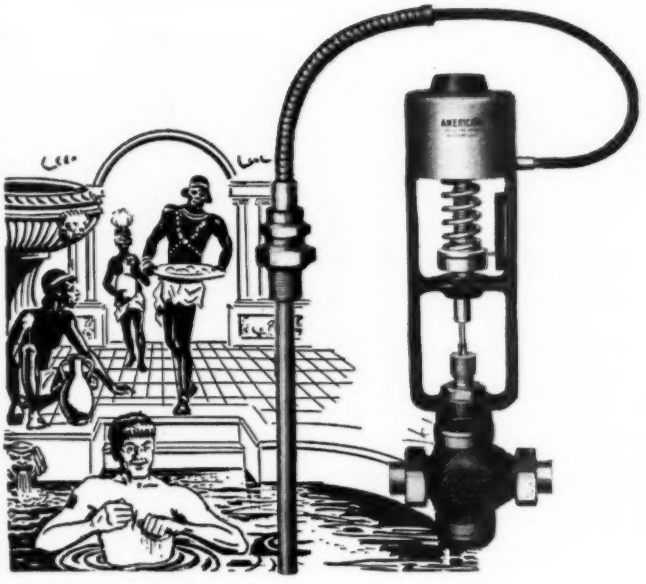
QUAKER PACIFIC RUBBER CO. • San Francisco 5 • Los Angeles 21



It took three slaves . . .

When the ancient Roman Severanius ordered that his bath water should always be kept at "a comforting warmth" three slaves were required to keep the fire going just right. Even then there were lapses, moments of forgetfulness and wrong guesses.

Had Severanius lived in 1947, AMERICAN Temperature Regulators would do the job safely, accurately, and without guess-work or forgetfulness.

AMERICAN Temperature Regulators provide the ultimate in precision control on hot water generators, feed water and fuel oil heaters, storage tanks and a host of other power and process plant services.

Special features include center guided Stainless Steel Seats and Discs ground to rigorous specifications of tightness, lifetime actuating bellows, ball-bearing adjustment, and over-temperature safety protection. Husky bronze valve bodies with union ends facilitate installation and prevent distortion due to possible misalignment of piping.

American Glass, Dial and Recording Thermometers are sold by leading distributors everywhere. Write to them or to us for information.

MANNING MAXWELL & MOORE INC. TRADE MARK

AMERICAN

Industrial Instruments

A Product of

MANNING, MAXWELL & MOORE, INC.

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Makers of 'American' Industrial Instruments, Hancock Valves, Ashcroft Gauges, Consolidated Safety and Relief Valves.

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(Not available for equipment advertising)
90 cents per line, minimum 4 lines. To figure advance payment count 5 average words as a line and allow 10 words for a publication box number address.
POSITIONS WANTED (full or part-time individual salaried employment only), ½ the above rates.
PROPOSALS, 75 cents a line insertion.

INFORMATION:
BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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This advertising rate is $10.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

P.

NEW ADVERTISEMENTS received by September 10th will appear in the November issue, subject to limitation of space available.

WANTED—GRADUATE ELECTRICAL, MECHANICAL AND STRUCTURAL ENGINEERS AND DESIGNERS

For power station, electrical transmission and distribution, and substation engineering, design, and operation. Location, Western Pennsylvania. Qualifications, experience record, and picture should be submitted with letter of application.

P-2045, Power
330 West 42nd Street, New York 18, N. Y.

WANTED
ENGINEERS

Wanted by Michigan firm of engineers, men qualified for structural and mechanical design, drafting, and construction supervision on power plant work. Answer to

P-276, Power
520 North Michigan Ave., Chicago 11, Ill.

Mechanical Engineer or Design Draftsman

who has had several years' experience, wanted for plant in Eastern Pennsylvania. One familiar with industrial, Power Plant, and/or Refinery piping installations and pressure containing vessels. Permanent employment and excellent opportunity for advancement with old established firm. State full details as to age, education, experience and salary expected.

P-1926, Power
330 West 42nd St., New York 18, N. Y.

MECHANICAL ENGINEER
WITH 15 TO 20 YEARS EXPERIENCE
In The Design of Steam Electric Generating Stations
FOR ADMINISTRATIVE POSITION
With a Large Eastern Utility

P-335, Power
330 West 42nd Street, New York 18, N. Y.

CHIEF ENGINEER
WANTED

Chief Engineer for well known established firm of Engineers & Constructors. Prefer man with 15 to 20 years of mechanical and process experience in Petroleum, Refining, Chemical and Power to organize and direct engineering work with complete responsibility. Excellent salary and bonus arrangement. Location—Midwest.

P-1935, Power
520 North Michigan Ave., Chicago 11, Ill.

WANTED

CHIEF OPERATING ENGINEER

By old established firm for high pressure boiler plant in large processing factory located on Northwest Side of Chicago. Must be experienced and capable of taking charge of maintenance and operation of boiler room and all processing equipment in plant. Should be capable of managing maintenance force. Salary to suit experience and ability. State experience in detail, age and salary desired in letter. Our own organization knows of this ad.

P-2008, Power
520 North Michigan Ave., Chicago 11, Ill.

WANTED

POWER PLANT

MECHANICAL ENGINEERS

Thoroughly experienced in design of modern plants and qualified to supervise engineering staff. Annual salary in neighborhood of $10,000. Location in greater New York area. Give full details of education, experience, age, availability, willingness to travel, etc.

P-1317, Power
330 West 42nd Street, New York 18, N. Y.

POSITIONS VACANT

WATCH ENGINEERS, New England utility needs operators for turbo-electric power plant. Experience burning fuel oil essential. State qualifications and references in first letter. P-1227, Power, 330 W. 42nd St., New York 18, N. Y.

WANTED—WATCH Engineers for power plant of a large industrial plant. A college degree is preferable, but may be offset by adequate experience, particularly in the operation and maintenance of large coal-burning boilers. P-1387, Power, 330 W. 42nd St., New York 18, N. Y.

ELECTRICAL ENGINEERS with some experience in substation and power plant design. Pleasant working conditions. Location in ideal home community. Write Electrical Engineer, Pennsylvania Power & Light Company, Allentown, Pa.

OPENING FOR junior sales and service man in small organization handling power plant equipment. Diesel knowledge helpful. P-1918, Power, 330 W. 42nd St., New York 18, N. Y.

LARGE MANUFACTURER in Southern Texas needs a qualified industrial engineer experienced in all phases of industrial engineering work including job evaluation, time study, work simplification, office and clerical procedures, etc., to expand work now being done mainly along the lines of Job Evaluation to include all applicable phases of industrial engineering work. Additional training or experience in chemical or petroleum engineering or similar technical fields would be desirable but not necessary. P-1913, Power, 520 N. Michigan Ave., Chicago 11, Ill.

INTERESTED SECURING services of competent experienced piping draftsman having fair knowledge of power piping standards for permanent employment in Midwest engineering organization. Communicate P-1809, Power, 520 N. Michigan Ave., Chicago 11, Ill., regarding salary and details of experience and submit brief digest of experience. Position will not require man to take independent charge but opportunities will be offered to develop under competent leadership.

OPERATING ENGINEER, Power House, for medium-sized industrial plant. New high-pressure plant being installed to operate along with low-pressure equipment for electric generation. Includes supervision of utilities such as water, compressed air and refrigeration. Should be able to control heat balance for efficient operation. Include qualifications, references and recent photograph; also give approximate salary desired. Middle Atlantic location. P-1762, Power, 330 W. 42nd St., New York 18, N. Y.

POWER PLANT Mechanic-Maintenance machinist, experience power equipment—turbines, boilers, engines, etc. Write to Robert Gair Company, Inc., Piermont, New York.

(Continued on page 310)

Additional Position Vacant ads on page 310

MECHANICAL DESIGNERS

With experience on design for Commercial and Industrial Buildings, including Chemical Plants, Power Plants and Laboratories.

Designers and checkers for Air Conditioning Pressure Vessels, Process and Power Piping, Plumbing, Sewer and Underground Piping.

Applicants for Design positions should be willing to perform board work in connection with their own designs.

Openings in our Cleveland and New York Offices.

Lengthy employment offering good salary for those who qualify.

Send complete resume stating experience, education, salary requirements and date of availability to either of the following addresses

THE H. K. FERGUSON COMPANY
Engineers and Builders
FERGUSON BUILDING
East 11th and Walnut, CLEVELAND, OHIO
or
19 Rector Street, New York, N. Y.

WANTED

Hydro & Steam Power Operating Engineer

For large manufacturing company using 225,000,000 kwh annually. Extensive experience in the operation of hydro-electric and steam-electric power system prerequisite. Must have Electrical or Mechanical Engineering degree.

Applicants please furnish personal data and experience record. State salary requirements.

All replies strictly confidential. Submit application and resume of qualifications to

P-1864, Power
330 West 42nd Street, New York 18, N. Y.

POSITION VACANT

Test Engineer under 25 years of age for modern pulverized coal fired steam electric generating station in Middle West. Experience or educational background such that he can be trained to make boiler water analyses, boiler and turbine tests and miscellaneous plant tests. State salary required.

P-1529, Power
520 North Michigan Ave., Chicago 11, Ill.

SALESMAN WANTED

having experience or following industrial plants. Experience our line not esssential. Car necessary. Lucrative permanent connection to right man. Give full particulars in reply. Will be treated confidential.

SW-1861, Power
330 West 42nd St., New York 18, N. Y.

(Continued from page 309)

SELLING OPPORTUNITY OFFERED

SALES ENGINEER: Experienced with high-pressure industrial boilers. Key territories available. Write manufacturer. SW-1812, Power, 68 Post St., San Francisco 4, Cal.

EMPLOYMENT SERVICES

SALARIED POSITION $2,500-$25,000. This thoroughly organized confidential service of 37 years recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated, through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONNEL $3,000-$25,000. This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 109 Church Street, New Haven, Conn.

POSITIONS WANTED

CHIEF ENGINEER, Centrifugal Pumps, 30 years experience in this specialty. Wide experience in practically all types from small close-coupled units to large mine pumps, boiler feeders, etc. Prefer firm wanting highly productionized new lines, or manufacturer of associated equipment desiring this additional product. Eastern location. PW-1419, 330 W. 42nd St., New York 18, N. Y.

STEAM POWER Plant Supervisor or results engineer—age 38; married; eighteen years experience all phases of hi-pressure steam plant operation testing and maintenance. PW-1793, Power, 520 N. Michigan Ave., Chicago 11, Ill.

STEAM POWER Plant Superintendent, non-professional, Canadian, married, family, forty-one years of age. Twenty-four years experience in erection, operation and maintenance of steam power plants, wishes to locate in U. S. Prefer newsprint mill, but will consider any reasonable offer. Details and references on request. PW-1947, Power, 330 W. 42nd St., New York 18, N. Y.

GENERAL FOREMAN Electrical. Experienced in supervision operation, maintenance and construction of hydro-electric power plants and systems. Generation to 130,000 KW, transmission to 230,000 V. Metering, relaying, electric and hydraulic control, dispatching. PW-1780, Power, 68 Post St., San Francisco 4, Cal.

WANTED

ANYTHING within reason that is wanted in the field served by Power can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

ENGINEER—MECHANICAL with PROFESSIONAL LICENSE

7 years' experience in production and development work—interested only in position requiring drive and ability.

PW 1895 Power
520 N. Michigan Ave., Chicago 11, Ill.

OFFICIAL PROPOSAL

(100)

Electric Generator Plants

The Iraq Embassy, 3141-34th Street, N.W., Washington, D. C., invites bids on a quantity of *100* complete diesel engine driven electric generator plants to meet with the following general specifications: (Detailed specifications available upon request)

DIESEL ENGINE:
Four stroke cycle, water cooled, engine speed not exceeding 1000 r.p.m. complete with all starting, operating and functional accessories including fuel service tank and exhaust muffler—all suitable for high ambient and tropical operation.

ALTERNATOR:
Direct connected type. Output between 40 k.w. and 60 k.w. (50kva and 75 kva at .8 p.f.) with adequate overload capacity at 120°F. ambient temperatures. Alternating current three phase, fifty cycles, 400/230 volts.

SWITCHBOARD:
Complete electric switchgear including automatic voltage regulator, circuit breaker, synchronising device, meters, switches, etc. necessary for satisfactory operation of set.

TOOLS:
Complete set of tools and essential spares.

FOR YOUR

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Electric motors, AC and DC
Compensators
Generators
Motor Generator Sets
Air and Oil Circuit Breakers
Panels
Exhaust Fans
Control Equipment
Send us list with full details

WIRE OR PHONE
P. O. Box 524

POWER EQUIPMENT CO.
373 S. COLEMAN ST., ROCHESTER

WANTED

TURBO-GENERATOR

Approx 2500 KVA 2300/3/60 180# pressure 20# + or — Extraction.

Not over 20 years old

EVANS PRODUCTS COMPANY
Coos Bay, Oregon

WANTED •

INDUSTRIAL ENTERPRISE

Large financially powerful diversified organization wishes to add another enterprise to present holdings.

CASH PAID

FOR CAPITAL STOCK OR ASSETS
Existing Personnel Normally Retained
STRICTLY CONFIDENTIAL
Box 1234, 1474 B'way, N. Y. 18, N. Y.

Air Compressors Wanted

Horizontal Water Cooled—Any size also 2 Stage portable units

L. W. BAUER
North Bergen, N. J.

WANTED

One M. G. Set

150-200 K.W.—125 Volt, Compound Interpole D.C. Generator—Driven by 220-3-60 Synchronous A.C. Motor of suitable size. Manual reduced voltage starter, suitable accessories acceptable.

OHIO VALLEY GENERAL HOSPITAL
Wheeling, West Virginia

WANTED

One 6000 or two 3000 KW condensing turbo generators 4160/3/60, steam pressure 110 PSI complete with condenser and auxiliaries.

REYNOLDS METALS COMPANY
Hurricane Creek Plant **Bauxite, Ark.**

WANTED FOR CASH

TURBINE GENERATING UNIT

1500 to 200 KW., 80% P.F., 3 phase, 60 cycle, 480 volts condensing steam turbine generator unit, 200# steam pressure at 125° Superheat furnished complete with a surface condenser, exciter, switchboard and instruments.

W-2034, Power
520 North Michigan Ave., Chicago 11, Ill.

—TRANSFORMERS—

TRANSFORMERS WANTED

in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
MARIEMONT **Since 1912** **CINCINNATI 27, OHIO**

A STANDARD OF QUALITY THAT IS NEVER LOWERED

Electrical Equipment

rebuilt and tested by our Electrical Engineers TO N. I. S. A. STANDARDS

MOTOR GENERATOR SETS

1—125 KW Crocker Wheeler 125 V, 1200 RPM. 2300 V., Squirrel Cage.
1—100 KW Elec Mach. 125 V., 1200 RPM. 4150 volt, synchronous.
1—100 KW General Electric, 230 v., 900 RPM. TS 4150 v. syn.
1—50 KW Ridgeway 1200 RPM. 550 Volt, Motor Sq. Cage, 220 volt.
1—5 KW General Electric, AC Gen. 1800 RPM. 120 volt, single phase, DC Motor, 230 volt.
4—100 KW General Electric, 60 volt, 1200 RPM. 125 HP Squirrel cage 220/440 volt.

ENGINE GENERATOR SETS

1—150 KVA General Electric, Ames Uniflow 220 volt, 3 phase, non-condensing.
1—62½ KVA Westinghouse 240 volt, 3 phase, Fairbanks non-condensing.
2—13 x 15 Uniflow Engines 150/300 RPM for Ice Compressors.
1—200/273 volt Gasoline Van Bierck 8 cyl. 1500 RPM.

TURBO GENEATO SET

1—300 KW General Electric ATB 240 Volt, 3 phase, condensing.
1—30 KW Allis Chalmers 3600 RPM. 125 volt, Terry Non-Condensing.

TRANSFORMERS

3—1000 KVA Single Phase General Electric, Type H, 4150 volt primary 230/460 secondary.
1—200 KVA Pittsburgh 4000 volt, single phase 110/220 volt secondary.
1—1000 KVA General Electric Auto transformer, 3 phase, 4150 volt, 3 phase, 2406 volts.
1—100 KVA 2400 volt primary. 240/480 secondary, G. E.
2—150 KVA 3 phase, 4320 high tension primary, 125/217 secondary, General Electric.
3—150 KVA Wagner, 440 volts primary, 120 volt secondary.
3—75 KVA 440 to 220 primary ,120 to 240 secondary.
5—50 KVA Westinghouse, 13,800 primary, 125 volt secondary.
5—50 Westinghouse, 12,800 primary, 240/120 secondary.
2—2500 KVA 12900 volts to 220 volts secondary.
1—100 KVA Westinghouse, 13200 volt, 250 volt, single phase.
10—27½ KVA General Electric brand new Air Cooled 440/220 220/110 single phase.
3—10 KVA Westinghouse Air Cooled, 450 volt, primary, 117 Volt secondary, single phase.
1—7½ KVA American 2200 volt primary, 230 volt, single phase.
1—7½ KVA Maloney 440 volt primary 110/220 secondary, single phase.

A. C. GENERATORS

500 KW General Electric .8 PF, 3600 RPM. ATB, 600 volts, DC exciter.
240 KW General Electric .8 PF, 600 RPM. ATB, 600 volts, DC exciter.
200 KVA Allis Chalmers, 3600 RPM. 240 volt, 2 phase, DC exciter.
200 KVA Westinghouse, 600 RPM. 240 volt, 3 phase, DC exciter.
200 KVA Allis Chalmers, 900 RPM. 240 volt, 3 phase, DC exciter.
180 KW Westinghouse, 514 RPM. .8 PF. 550 volt, 3 phase.
2—167 KVA General Electric, 1200 RPM. .6 PF. 450 volt, 3 phase.
165 KW Electric Machinery, 514 RPM. 240 volt, 3 phase.
120 KW General Electric, ATB, .8 PF. 720 RPM. 2300 volt, 3 phase.
100 KW General Electric, ATB, 600 RPM. 240 volt, 3 phase, DC exciter.
62½ KW Allis Chalmers, 3600 RPM. 220 volt, 3 phase, DC exciter.
35 KW Columbia Elect. .8 PF. 1200 RPM. 240 volt, 2 phase, DC exciter.
31.3 KVA American Customs, .8 PF. 1200 RPM. 120/208 volt, 3 phase, DC exciter.
12.5 KVA Westinghouse, .8 PF. 1200 RPM. 240 volt, 3 phase, DC exciter.

SYNCHRONOUS MOTORS

200 HP Elec. Machinery, 450 RPM. 440 volt, 3 phase.
153 HP General Electric, T.S. 900 RPM. 4160 volt, 3 phase, DC exciter.
75 HP, 1200 RPM. General Electric, 440 volt, 3 ph., DC exciter.
70 HP Electric Machinery, 180 RPM. 2200 volt, 3 phase.
40 HP Westinghouse, 1800 RPM. 220 volt, 3 phase, DC exciter.
35 HP General Electric, 1200 RPM. 2200 volt, 3 phase, DC exciter.
20 HP Westinghouse, 1800 RPM. .8 PF. 220 volt, 3 phase.

MOTORS—3 ph. 60 cycle
SQUIRREL CAGE

1—125 HP U. S., 1200 RPM. vertical hollow shaft, 220 volt, 3 phase, 60 cycle.
1—450 HP Ridgeway 900 RPM. 2200 volt, 3 phase.
3—40 HP General Electric, Type KT, 900 RPM. 220 volt, 3 phase.
1—35 HP General Electric, Type 1, 600 RPM. 350 volt, 3 phase.
2—10 HP Westinghouse gear 440 RPM. output 440 volt, 3 phase.

MOTORS—3 ph. 60 cycle
SLIP RING

1—450 HP General Electric, 425 RPM. ITC, 440 volt, 25 cycle.
1—100 HP General Electric, 720 RPM. IM, 440 volt, 25 cycle.
1—50 HP F & B, 1800 RPM. BV, 220 volt.
1—50 HP General Electric, 900 RPM. IM, 440 volt.
1—40 HP Cont. 1150 RPM. SA55, 220 volt.
1—40 HP General Electric, 1130 RPM. MT, 220 volt.
1—40 HP General Electric, 900 RPM. MT, 220 volt.
1—40 HP General Electric, 900 RPM. MTI, 2000 volt.

JLHCo

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J. L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

POWER PLANT MACHINERY

750 KVA NORDBERG UNIFLOW ENGINE GENERATOR UNIT

600 KW 80% P.F. 750 KVA General Electric alternating current generator 3 phase 60 cycle 4000/2300/600/480/240 volts 150 RPM direct connected to Nordberg uniflow noncondensing engine, 150-200# steam pressure, 0-15# back pressure. This unit is in excellent condition, available for immediate delivery.

CONDENSING TURBO UNITS

3 phase 60 cycle

12500 KVA Wstgh. 2400 volts 200# steam
7500 KVA G.E. 2400 volts 250# steam
3750 KVA Wstgh. 4160 volts 200# steam
2500 KVA Allis 2400 volts 200# steam
2250 KVA G.E. 480 volts 250/400# steam
1875 KVA G.E. 480 volts 225# steam
1563 KVA Allis 2400 volts 200# steam
1250 KVA G.E. 2400/600 volts 250# steam
937 KVA G.E. 480 volts 150# steam
375 KVA G.E. 480 volts 400# steam

NONCONDENSING TURBO UNITS

3 phase 60 cycle

2500 KVA G.E. 480 volts 150# steam, 15# exhaust
1250 KVA Wstgh. 2400 volts 300# steam 10# exhaust
937 KVA Moore 2400 volts 175# steam 20# exhaust
750 KVA G.E. 480 volts 115# steam 5# exhaust
625 KVA Wstgh. 480 volts 300# steam 10# exhaust
375 KVA Terry 240 volts 200# steam 100# exhaust
375 KVA G.E. 240 volts 150# steam 10# exhaust
250 KVA G.E. 480 volts 200# steam 5# exhaust
187 KVA G.E. 480 volts 250# steam 15# exhaust
187 KVA Wstgh. 240 volts 125# steam 25# exhaust

EXTRACTION TURBO UNITS

3 phase 60 cycle

3750 KVA Wstgh. 2400 volts 150# steam, 10# extraction
2500 KVA G.E. 600 volts 225# steam, 20# extraction
1250 KVA Allis 480 volts 300# steam, 35# extraction
1250 KVA Elliott 480 volts 150# steam, 60# extraction
625 KVA Wstgh. 480 volts 250# steam, 25# extraction

UNIFLOW UNITS

3 phase 60 cycle

750 KVA Skinner, 2400 volts, 175# steam, 15# exhaust
575 KVA Skinner, 240 volts, 200# steam, 5# exhaust
375 KVA Skinner, 2400 volts, 150# steam, 5# exhaust
312 KVA Skinner, 480 volts, 175# steam, 5# exhaust
240 KVA Ames, 240 volts, 125# steam, 5# exhaust
200 KVA Skinner, 240 volts, 125# steam, 5# exhaust
187 KVA Ames (vertical) 240 volts 150# steam, 5# exhaust

BOILERS

60,000 lbs/hr Springfield 225 lbs. steam 500 deg. T.T., pulverizer
37,500 lbs/hr Heine 400 lbs. steam 620 deg. T.T., oil burner
35,000 lbs/hr B&W 425 lbs. steam 700 deg. T.T., stoker
30,000 lbs/hr B&W 525 lbs. steam 600 deg. T.T., pulverizer

DIESEL UNITS

3 phase 60 cycle

625 KVA Fulton 480 v.
575 KVA McIntosh-Sey. 2400 v.
432 KVA Worthington 2400 v.
350 KVA Worthington 2400 v.
250 KVA General Motors 480 v.
250 KVA Fairbanks Morse 2400 v.
213 KVA Fairbanks Morse 2400 v.
187 KVA Fairbanks Morse 2400 v.

MOTOR GENERATOR SETS

3 phase 60 cycle

1000 KW G.E. 600 v D.C; 6600/11400 v A.C.
300 KW G.E. 250 v D.C; 440 v A.C.
200 KW G.E. 250 v D.C; 440 v A.C.
200 KW C.W. 125 v D.C; 2300 v A.C.
150 KW Reliance 250 v D.C; 4150 v A.C.
60 KW G. E. 125 v D.C; 440 v A.C.

ROTARY CONVERTERS

3 phase 60 cycle

3500 KW G.E. 225/285 v D.C., 13800 v A.C.
2000 KW Allis 600 v D.C., 4150 v A.C.
1500 KW Wstgh. 600 v D.C., 4000 v A.C.
1000 KW G.E. 600 v D.C., 13200 v A.C.

RECTIFIERS

3 phase 60 cycle

3000 KW G.E. 600 v D.C., 13800 v A.C.
900 KW Brown Boveri 600 v D.C., 2300/13800 v D.C.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. **Telephone Main 9514** **CLEVELAND 14, OHIO**

BELYEA SAYS: "Our reputation is your protection!"

WHEN YOU BUY

RE-NU-BILT REBUILT—BY SPECIALISTS ELECTRICAL EQUIPMENT

MOTOR GENERATOR SETS

3 ph. 60 cycle

1—1000 K Whse. 600 V. D.C., to 1400 HP. 2300/4000 V. Syn. Motor.
1—1000 KW Al. Ch. 450 V. d.c. to 1250 Kva 2300 V. Syn. Motor.
1—600 KW G.E. 3 unit with 2-300 KW 250 v.
2—500 KW G.E. 600 V. D.C. to 710 H.P.—4400 V. Syn Motor with exciter. Gens. d.c. to 850 HP. 2300 v.
1—500 KW G.E. 600 V. d.c. to 700 HP—13200
1—400 KW G.E. 3 Unit with (2) 200 KW 125 V. d.c. to 600 HP—2300 v. Syn.
1—400 KW Whse. 250 V. d.c. to 600 HP—440 V. Syn. with exciter.
1—300 KW G.E. 250 V. D.C. to 360 KVA—440 V. Syn. Motor with exciter.
1—300 KW G.E. 550 V. d.c. to 435 HP—2300/4000 Syn. with exciter.
1—250 KW G.E. 275 V d.c. to 350 Kva 2300/4000 Syn. with exciter.
1—250 KW Al. Ch. 250 V. d.c. to 340 Kva—2300 V.
1—200 KW G.E. 125 V. d.c. to 300 HP 440 V. V. Syn. with exciter.
1—150 KW Whse 600 V. d.c. to 225 HP—2300 V.
1—100 KW G.E. 125 V. D.C. to 150 H.P.—220 V. Ind. Motor.
4—90 KW G.E. 62½ V. D.C. to 135 H.P.—220/440 V. Ind. Motor with unit controls.
2—75 KW Cr. Wh. 250 V. D.C. to 125 H.P.—220/440 V. Ind. Motor.
1—75 KW G.E. 125 V. d.c. to 120 HP—4000/2300 V. Ind.
1—40 KW Cr. Wh. 250 V. D.C., to 100 HP. 220/440 V. Ind. Motor.
1—50 KW G.E. 125 V. D.C. to 75 H.P.—220 V. Ind. Motor.
2—48—KW G.E. 3 unit with (2) 24 KW, 60 V. gens. d.c. to 75 HP, 440 V. Ind.
1—35 KVA Whse. 240v., 3 ph., 60 cy. A.C. gen. with 35 HP—230 V. d.c. motor.

FREQUENCY CHANGER SETS

1—1000 KW—GE—2 Unit—3 Brg. Consisting of—1400 HP—4400 V. 3 ph. 25 Cy. Motor and 1000 KW—2300 V—8 ph. 58.3 cycle gen. with exciter (Gen. can be reconnected for 800 KW 3 ph.)
1—840 KW—GE—2 unit with 2 exciters consisting of 1700 HP—2300 V. 3 ph. 25 cycle motor and 1200 Kva.—.7 pf. 2400 V. 3 ph. 60 cycle gen.

ROTARY CONVERTERS

60 cycle

KW	Make	Speed	Volts	Volts
1—1500	Whse.	720	600	2300
1—1000	G.E.	900	600	13200
1—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
1— 750	Whse.	720	250	6600
1— 500	Whse.	1200	600	13200

TURBO-GENERATOR SETS

1—3000 KW Whse. 3750 Kva. 2300 V. 3 ph. 60 cy. with Parsons 200 lb. Cond. turbine.
1—3000 KW G.E. 3750 Kva. 2300 V. 3 ph. 60 cy. with G.E. 200 lb. Cond. turbine.
1—2500 KW G.E. 3125 Kva. 600 V. 3 ph. 60 cy. with 200 lb.; 15 lb. auto extraction turbine.

SPECIAL

1—2500 KVA G.E. Auto Extraction, 225 lbs., 500" F.T.T.—20 lbs. extraction. Surface condenser, 600 volt, 3 phase, 60 cycle. Panel and all auxiliaries.

1—2000 KW G.E. 6600 V. 3 ph. 60 cy. with G.E. 175 lb Cond. turbine and d.c. exciter.
1—2000 KW G.E. 3125 Kva. 480 V. 3 ph. 60 cy. with 175/200 lb.; 25 lb. auto extraction.
1—1500 KW G.E. 1875 Kva. 480 V. 3 ph. 60 cy. with G.E. 200 lb. Cond. turbine.

SPECIAL

1—1500 KW G.E. Non-Condensing 160/175 lbs. ISP-5/10 B.P. with 1875 KVA-480 V. 3 ph. 60 cy. gen. and direct connected exciter.

2—1250 KW G.E. 1560 Kva. 2300 V. 3 ph. 60 cy. with G.E. 175/200 lb. Condensing turbine.
1—1250 KW G.E. 600 V. 3 ph. 60 cy. with G.E. 175 lb. Cond. turbine and d.c. exciter.
1—1250 KW Al. Ch. 1560 Kva. 2300 V. 3 ph. 60 cy. with 200 lb. Condensing turbine.
2—1000 KW G.E. 1250 Kva.—2300/4160 V. 3 ph. 60 cy. with G.E. 135/175 lb. Cond. turbine.
1—500 KW G.E. 625 Kva.—240/480 V. 3 ph. 60 cy. with G.E 200 lb. Cond. turbine.
1—300 KW G.E. 375 Kva. 480 V. 3 ph. 60 cy. with G.E. 80/100 lb. Cond. turbine.
1—300 KW G.E. 375 Kva. 480 V. 3 ph. 60 cy. with G.E. 200 lb., 10 lb. back pressure turbine.
1—300 KW Al. Ch. 120/240 V. d.c. geared to Whse. 440 lb. Cond. turbine.
1—200 KW G.E. 600 V. 3 ph. 60 cy. with 150 lb. non cond. turbine and exciter.
1—125 Kva. G.E. 2300 V. 3 ph. 60 cy. with 125/200 lb Non-Cond turbine.
4—60 KW Whse., Condensing, 200 lbs. with 60 KW, 120 V. D.C. Gen.

SPECIAL

500 HP — GE — KF-559 — 3575 RPM — 2300 Volt Sq. Cy. Motor connected to Byron Jackson 325 GPM—10 stage 3500 ft. head pump.

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
1— 600	G.E.	TS-7640	2300	900
1— 600	G.E.	ATI	600	900
2— 350	G.E.	TS	2200	150
1— 200	G.E.	TS-965	2300	720

SLIP RING

1—1000	Whse.	CW	2300	705
1— 900	G.E.	IM	2300	880
1— 750	Whse.	CW	2200	327
1— 450	Cr Wh.	SR-31	2300	392
1— 450	G E	1	440	506
1— 350	G E.	MT-442Y	2200/4000	253
1— 250	Whse.	CW	2200	500
3— 200	G.E.	IM	440/550	435
1— 250	G.E.	MT-424Y	4000	257
1— 100	Al. Ch.	ANY	220	435
2— 100	G.E.	IM	2200	435

SQUIRREL CAGE

2—800	Whse.	CS-1221A	2200	704
1—700	G.E.	ICT	2300	705
3—600/450	Whse.	CS	2300	585/439
1—250	G E.	IK	440	900
1—250	Al. Ch.	AN	220	1160
1—200	G.E.	IK	550	865
1—150/70	G.E.	IK	440	1170/870
1—100	G.E.	IK (Vert.)	2300	450
3—100	G.E.	IK	2200	600
1—100	G.E.	IK	220	865

SPECIAL
MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V. D.C. Form C with 2300 V. 60 Cycle transformer and switching equipment.
1—500 KW—GE—Type RHW — 6 Anode 575 V. D.C. Form B with 2300 V. 60 Cycle transformer and switching equipment.

D. C. MOTORS

HP	Make	Type	Volts	Speed
2—800/1000	Whse.		450	600/720
1—800	G E.	MPC	600	600
1—700	G.E.	MCF	600	180/525
1—650	G E.	MPC	250	115/145
1—350	Whse.		230	300/900
2—350	G.E.	MPC	250	450
1—335	Whse.	MQ	250	300/900
1—300	G E.	DMC	230	400/600
1—300	G.E.	MPC	230	275/550
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	280/450
1—150	Cr. Wh.	CMC-65H	230	1150
1—130	Cr. Wh.	CMC-51H	550	1200
2—125	G.E.	CO-1832	230	625
1—125	GE	CD 125	230	1150
4—101	Whse.	8K (Vert.)	230	489/950

"Successful operation guaranteed"

BELYEA COMPANY, INC.

39th YEAR

Main Office and Shop
43 HOWELL ST., JERSEY CITY 6, N. J.
Phone—Journal Square 2-3334
Also N. Y. City Line—Rector 2-7150

GLOW ELECTRIC CO.

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
400	1200	440	GE-IK
350	514	440	GE-I
250	600	2300	Triumph
223	3600	4150	GE-FR
200	600	2300	C-W
150	600	220	GE-I
150	600	2300	GE
150	450	220	GE-I
125	1800	2300	A-C
125	3600	220	A-C-AN
100	1800	2300	Burke-EM
100	514	220	A-C
100	450	220	A-C
75	720	2300	Wagner
75	600	440	GF-I
75	360	220	GE-I
60	3600	2300	GE-KT
60	1800	2300	Wtg.-CS
50	720	2300	Wtg.-CS
40	900	2300	Wtg.-CS
35	600	220	Triumph
25*	1200	220/440	Wtg.
25	1200	2300	GE-I
25	900	220	GE-FTR
25	900	220	Wtg.-CS
25	720	220	Wagner
25	600	440	GE-I
20*	1800	220/440	F-Morse
20*	1200	2300	F-Morse
20	900	440	Wtg.-CCL
20	900	2300	Wtg.-CS

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TEFC-BB
10*	1800	dual	Master-TEFC-BB
10	1800	440	GE-TEFC-BB
5*	1800	dual	Master-TEFC-BB
5	1800	220	Wagner TE-BB
5*	1200	dual	GE-TEFC-BB
3	3600	440	Wtg.-TE-BB
3	1800	dual	Delco-TEFC-BB
3	1200	dual	Rel.-TEFC-BB
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	1800	dual	L. Al.-TE-BB
1½	1200	dual	Rel--TEBB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1*	1200	dual	Rel.-TE-BB
¾	3600	440	Delco-TE
¾	1800	dual	Wesche-TE-BB
½	3600	220	Ohio-TE-BB
½	1800	440	Wtg.-TE-BB
½*	1800	dual	Delco-TE-BB
½	1200	220	Cr. Wh.-TE
¼	3600	440	GE-TE
¼	1800	220	Delco-TE-BB
¼	1800	440	Delco-TE-BB

* New Motor

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
400	900	440	GE-IM
375	1800	2300	Al. Ch.
235	1800	220	GE-I
250	300	2300	Al. Ch.
200	514	440	Triumph-C
75	720	2300	Wagner-BR
75	450	440	Wtg.-CW
75	360	220	GE-I-M
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	Wtg.-CW
40	900	2300	Al. Ch.
40	900	220	Wtg.-HF
40	720	2300	Wtg.-HF
40	720	220	Al. Ch-ANY
40	600	2300	Al. Ch-ARY
40	600	220	Al. Ch.-ANY
40	450	220	Triumph-C
35	900	2300	Ridgeway
35	720	220	GE-I
30	1800	2300	Wtg.-CW
30	1200	440	GE-I
30	1200	2300	Lincoln
30	900	220	GE-MT
30	900	2300	Ridgeway
30	720	220	GE-I
30	600	2300	Al. Ch.-ARY
30	600	220	F. Morse-BV
25	1200	2300	Al. Ch.-ANY
25	900	220	GE-MT
25	720	dual	Watson-KH
25	600	220	Watson-KH
20	1800	440	Al. Ch.
20	900	2300	GE-I

VERTICAL MOTORS

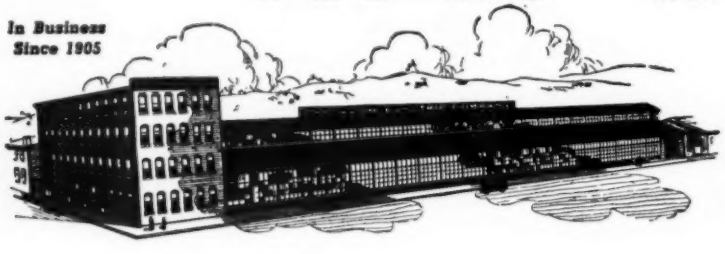
HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
150	1200	2300	GE-SR
150	1200	440	GE-Cage
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
75	514	440	GE-Cage
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60	1200	440	Al. Ch.-Cage
50	1800	440	GE-Cage
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	220	GE-Cage
40	950	230 D.C.	Wtg.
35	1200	440	GE-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage
25	850	230 D.C.	Wtg.
20	1200	440	Al. Ch.-Cage

VERTICAL MOTORS—Cont'd

HP	RPM	Volts	Make
20	800	230 D.C.	GE
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
15	600	440	Al. Ch.-Cage
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
10	900	220	Wtg.-Cage
7½	1800	500 D.C.	Peerless
7½	900	440	GE-Cage
7½	700	230 D.C.	GE-Cage
6	850	110 D.C.	Rel.
5	1400	230 D.C.	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage
3	900	440	Wtg.-Cage
3	600	dual	Wtg.-Cage
2	1800	230 D.C.	GE
2	1800	220	L. Al.-Cage
2	1180	230 D.C.	Wtg.
2	900	220	GE-Cage
1	1200	220	GE-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
1200	900	440	GE
600	720	2300	Al. Ch.
500	1800	2300	GE
300	900	2300	E-M
300	900	440	GE
250	720	440	GE
250	225	2200	GE
250	225	440	GE
235	1200	2200	E-M
200	900	2200	Wtg.
200	720	2300	GE
200	225	2200	Wtg.
175	225	208	GE
160	600	440	GE
160	164	440	GE
150	1800	220	GE
125	900	2200	GE
125	150	440	GE
120	225	220	E-M
115	164	208	GE
75	1200	dual	E-M
75	900	2300	GE
60	360	2200	GE
50	1200	440	Wagner
50	360	440	GE
30	900	440	Wagner
30	720	440	GE
30	600	550	GE
30	450	dual	Wtg.
30	360	550	GE
30	327	220	E-M
25	1800	220	Wagner
25	450	220	E-M
25	300	220	Ideal
20	900	220	Wtg.
20	600	220	E-M
15	1800	220	Wagner
10	1800	220	Wagner
10	1200	220	Wagner
7½	1200	440	Wagner



DIRECT CURRENT GENERATORS

KW	Volts	RPM	Manufacturer	Description
400	120/240	300	Westinghouse	Compound, Interpole Pedestal Bearings
200	250	375	Jantz & Leist	Compound Wound, Pedestal Bearings
175	250	450	Westinghouse	Compound Wound, Pedestal Bearings
80	125	500	Jantz & Leist	Compound Wound, Double Shaft Extension
80	125	400	Jantz & Leist	Compound Wound, Double Shaft Extension
30	250	300	Triumph	Compound Wound
22½	250	765	Westinghouse	Compound Wound

TRANSFORMERS

General Electric Spirakore Transformers, 167 KVA, 2400/4160Y volt primary, 120/240 or 240/480 volt, secondary, 1 phase, 60 cycle, oil cooled, outdoor type.

MOTOR GENERATOR SETS

KW	Volts	Generator Mfgr.	A. C. Motor
500	600	General Electric	710 HP, 1.P.F., 720 RPM, 13200/6600 Volts, General Electric, Synchronous
*300	250	General Electric	450 HP, 1200 RPM, General Electric, Synchronous
200	230/250	Crocker-Wheeler	300 HP, 1.P.F., 600 RPM, 2300 Volt, Allis-Chalmers, Synchronous
200	125	General Electric	300 HP, 900 RPM, General Electric, Synchronous
50	120/125	Burke	95 HP, 1200 RPM, Burke, Synchronous
*50	115/230	Westinghouse	75 HP, 1800 RPM, Westinghouse, Induction
40	250	Reliance	60 HP, 1800 RPM Century, Induction
25	125	General Electric	35 HP, 1200 RPM, General Electric, Induction

* These Motor Generator Sets are unused.

AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC HOISTS
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

933-943 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

SINCE 1910—EQUIPMENT THAT PERFORMS!

1 YEAR GUARANTEE

125 V. - 250 - 550 V D.C. GENERATORS (Motor Driven and Belted)

KW	Make	Voltage	Ampere	Speed
600	Al.-Ch.	250	2000	900
250	G.E.	125	2000	690
200	G.E.	125V	1600	900
200	Cr. Wh.	550	363	900
175	Cr. Wh.	250	700	1200
150	G.E.	250	600	580
150	G.E.	125	1200	1200
150	West.	250	600	1150
125	G.E.	250	500	850
125	Ideal	250	500	1500
100	G.E.	125	800	730
75	West.	250	300	870
40	G.E.	250	160	1150
40	Century	125	320	1450
40	West.	250/125	160	1500
40	G.E.	250	160	800
25	Allen	110	320	500
20	Delco	125	160	1200
20	Col. (3)	125	160	1750
15	G.E.	125	120	1750
15	West.	230	60	1450
15	G.E.	125	120	1150
15	G.E.	125	120	850
10	Rogers (2)	125	80	1450
10	El. Dy.	125	80	600
8	G.E. (2)	125	64	1800
7½	G.E.	125	60	1800
5	G.E. (2)	125	40	1740
5	Rel.	250	20	1725

80—Additional generators—125 V. up to 200 V. generators in stock.

600 H.P. Westinghouse Synchronous Motor, 900 RPM, 3 ph. 60 cy. 2300 volts Complete Manual Red. Volt. Starting—Latest type

3—500 H.P. Electric Machinery Synchronous Motors, 3 phase, 60 cycle, 440 volts, 514 RPM, complete with starting equipment. Latest type.

LOW VOLTAGE D.C. GENERATORS

KW	Make	Voltage	Ampere	Speed
105	West.	75	1500	1150
75	G.E.	75	1000	1145
22½	West.	75	300	720
90	Century	60	1600	1150
1-½	G.E.	60	19	1800
3	Hertner	60	60	1730
40	G.E.	50	800	1160
3½	G.E.	42	205	1800
5	Diehl	40	125	1750
33	G.E.	33	1000	850
39	G.E.	32	1200	1750
6½	G.E.	32	205	1800
3	G.E.	30	100	1200
6	Star (2)	25	250	1800
5	Star	25	200	1750
15	Rel.	24	625	1450
4	Star	20	200	1800
1	West.	16	60	1750
11	Star	15	750	1200
1	Cont. (2)	15	67	1750
4½	Star	15	300	1800
30	Columbia	8-16	5000/2500	720
12	H.V.W.	12/24	1000/500	900
12	H.V.W.	6/12	2000/1000	720
6	Columbia	6/12	1000/500	1200

300—Additional low voltage generators in stock.

NEW MOTORS IN STOCK

1 HP. to 30 HP.
3 ph. 60 cy. 220/440 V.
1200 & 1800 RPM
Ball Bearing
Nema Frames

230 V. D. C. MOTORS

Qu	H.P.	Make	Type	Speed
1	125	G.E.	RC	1750
1	100	West.	SK-1 0	625
1	100	Rel.		475/635
1	100	Rel.	1050T	400/1200
1	75	West.	SK	475
1	75	Cr. Wh.	New	480/670
1	75	Cr. Wh.	CMC	375/750
3	60	West.	SK-160	680
1	60	G.E.	C	480/1100
1	45	Diehl	K-10	850
2	40	G.E.	DLC-25	1050
8	40	G.E.	CD1441	250/1500
1	40	Cr. Wh.	CCM	700
1	35	G.E.	RLC-204	440/800
1	35	G.E.	RF	500/1500
1	35	West.	SK-160	400
1	30	G.E.	RC-32	1100
1	30	West.	S-6	1025
1	30	West.	SA	975
2	30	West.	SA	500/1500
2	25	G.E.	RC-31	1150
1	25	West.	SK	1100
1	25	Rel.	92T	1150
1	25	West.	SK	900
4	25	G.E.	RF-1	500/1500
1	25	West.	SK	500/1500
1	25	G.E.	RF-11	500/1500
2	25	G.E.	RF-14	300/1200
1	25	G.E.	RF-14	300/900
1	25	West.	SA	325/975
1	20	G.E.	CD-85	1150
1	20	G.E.	RC-11	1150
1	20	West.	SK-103	1200
1	20	West.	S-6	975
2	20	West.	SK-83	850
1	20	G.E.	RC	800
1	20	Al. Ch.	Series	625
1	20	West.	HY-6	700
1	20	G.E.	RF-11	500/1500
10	20	G.E.	RF-12	400/1200
2	20	Star	SHB-20	29.2
2	16/25	Cr. Wh.	35-JA	400/1200
1	15	Roch.		3450
4	15	Star	SQ-1520	1290
1	15	G.E.	RC	1200
1	15	West.	SK-80L	1100
1	15	G.E.	RC-29	1150
1	15	G.E.	RC-10	1150
1	15	G.E.	CDC-85	900
1	15	West.	SK	850
1	15	G.E.	CDE-83	850

230 V. D.C. MOTORS (Cont.)

Qu	H.P.	Make	Type	Speed
2	15	G.E.	RC-30	850
1	15	West.	SK	675/1350
1	15	El. Dy.	58	600/1200
1	15	G.E.	CQ	600/1500
1	15	G.E.	LC	675/1150
2	15	West.	SK-100L	600/1500
1	15	G.E.	RF-11	400/1600
1	15	West.	SK	250/1100
1	15	Diehl		200/247
1	10	G.E.	CD-75	1150
1	10	G.E.	RC	1100
1	10	Triumph	TR-108	860
1	10	G.E.	RC-29	850
1	10	Diehl	LS-14	750
1	10	West.	SK-7L	700
1	10	Cr. Wh.	CSM	675
1	10	West.	SK	600/1200
2	10	G.E.	RLC	500/1500
1	10	G.E.	RF-10	400/1600
1	10	West.	SA	400/1200
1	10	G.E.	RF-10	400/1200
1	10	Rel.	131T	250/1000
2	10	West.	Gr. Hd.	3/10
1	7½	Sturt		3600
1	7½	L.A.	284	1750
1	7½	El. Dy.	28	1750
1	7½	G.E.	RC	1700
1	7½	West.	SK	1800
2	7½	Cr. Wh.	CCM	1425
3	7½	West.	SK	1100
1	7½	G.E.	RC	1100
1	7½	G.E.	CO-1804	1260/3200
2	7½	West.	SK-50	975
1	7½	G.E.	RC	900
1	7½	Cr. Wh.	CCM	875
2	7½	G.E.	RC	850
1	7½	West.	SK-60	850
1	8½	West.	SK-30	825
1	7½	G.E.	RF-10	600/1500
1	7½	West.	SK-90	650/1300
1	7½	El. Dy	38	550/1650
2	7½	L.A.	BW-15	525/1150
1	7½	Roth	RS-107	450/900
1	7½	West.	SK-70	400/1600
1	7½	West.	SA	400/1600
1	7½	G.E.	RLC	400/1600
1	7½	Al. Ch.		350/1050
1	5	Star	SB-5	1750
1	5	Rel.	T-284	1750
2	5	G.E.	RC	1700
1	5	G.E.	CDV	1750
1	5	G.E.	CVC	1650
1	5	G.E.	CD-85	1150
1	5	Rel.	32T	1150
8	5	G.E.	RC-27A	1150
2	5	West.	SK-45	1150
1	5	G.E.	B-284	1150
1	5	West.	SC-3	870/1750
1	5	Rel.	23T	850/1700
1	5	Al. Ch.	E-75	00
1	5	G.E.	RC	800
1	5	Cont.	D-49	600/1800
1	5	Star	SB-10	600/1200
1	5	El. Dy.	3-S	550/1650
2	5	West.	SK-60	500/1500
1	5	Cr. Wh.	CM	400
2	3	G.E.	BD-235	3600

800—Smaller D.C. motors in stock including fractional.

110 V. D.C. MOTORS

Qu	H.P.	Make	Type	Speed
1	25	Star	15-L	2400
1	25	G.E.	CDM-95	1000
1	20	G.E.	CD-83	1750
1	16	Cr. Wh.	CMC-L	1750
1	15	West.		1150
1	15	El. Dy.	7½ S	815/1230
1	15	West.	S	560
4	10	Lincoln		3500
1	10	L. A.		3500
1	10	Al. Ch.	EBC-75	2175
1	10	G.E.	CD-73	1750
1	10	West.	SK-70L	850
1	10	Cont.		825
1	10	Rel.		400/1600
1	10	Diehl.		330

600—Smaller size 110 V.D.C. motors including fractional horsepower motors also in stock.

NEW

Direct Current
Manual and Automatic
Starters

CUTLER - HAMMER
GENERAL ELECTRIC
WARD - LEONARD

230 Volts

164—1 H.P. Manual
24—1 H.P. Automatic
197—1½ H.P. Manual
206—2 H.P. Manual
119—2 H.P. Automatic
270—3 H.P. Manual
95—3 H.P. Automatic
343—5 H.P. Automatic
9—10 H.P. Automatic
3—20 H.P. Automatic
19—60 H.P. Automatic
50—75 H.P. Automatic

115 Volts

19—1 H.P. Manual
8—1½ H.P. Manual
8—2 H.P. Manual
23—3 H.P. Manual
398—5 H.P. Automatic
1—60 H.P. Automatic

You must BUY!
at our prices on
these starters.

SEND US YOUR INQUIRIES FOR A. C. EQUIPMENT

L. J. LAND, INC.

Established 1910 **146 GRAND STREET, NEW YORK 13, NEW YORK** **CAnal 6-6976**

New England Representative
BOSTON, MASS., 411 Atlantic Ave.
***Phone:* Liberty 4300**

Pennsylvania Office
READING, PA., 10th & Exeter Sts.
***Phone:* Reading 2-6866**

. . . always a wide selection . . . always unusual values

Listed below a few of the motors available in a hurry from Wente

SQUIRREL CAGE

3 Phase, 60 Cycle, 200/440 Volt

(Other voltage as noted)

Qu	HP	Make	Type	Speed
1	250	G.E.	KF Vert.	3600
1	150	Al. Ch.		1750
1	150	G.E.	I-17 550 Volt	400
1	125	Cr. Wh.	126Q	430
1	120	G.E.	FT	3600
1	100	Howell	8CBB	1800
2	50	R.&M.	L	1200
1	50	Al. Ch.	AN	900
1	50	G.E.	I 2200 Volt	900
1	50	F. M.		900
1	50	G.E.	I	720
1	50	West.	MS 25 Cycle	720
1	50	Wagner	BM	495
1	50	Al. Ch.		490
2	35	Al. Ch.	2 Phase	900
1	35	Al. Ch.		900
1	35	G.E.	I 25 Cycle	730
1	30/30	West.	CS TEFCBB	1800/900
1	30	F. M.	QZK Open BB	1200
1	30	Cr. Wh.		900
2	30	Al. Ch.	AN 2 Phase	900
1	30	Century	AS	720
1	25	Howell		1700
1	25	F. M.	QZK B. B. New	1200
1	25	Wagner	BP	1200
1	25	Burke	EM3	900
1	25	Lincoln		900
1	25	Al. Ch.	AN	720
1	25	G.E.	M10	720
1	25	West.	MS 25 Cycle	600
2	20	U. S.	SC SPBB	1800
2	20	F. M.	QZK B. V. New	1800
1	20	West.	CS	1800
1	20	Howell	N Vert. B.B. New	1200
1	20	F. M.	KRV	1200
1	20	Cr. Wh.		900
1	20	G.E.	I-K 2200 Volt	900
1	20	Cleve.	M	900
1	20	Al. Ch.		900
1	20	West.	MS 25 Cycle	900
1	18	West.	MS (Elev.)	720
1	15	F. M.	HLS	3600
4	15	F. M.	QZK B. B. New	1800
2	15	West.	MS 25 Cycle	715
1	10	Al. Ch.		1800
1	10	Imperial	EH B. B.	1200
1	10	West.	CS 25 Cycle	725
5	7½	G.E.	KT	1800
1	7½	West.	CS	1800
3	7½	Wagner	11VRW	1800
3	7½	G.E.	KT	1200
20	3	Imperial	E (New)	1200

Approx. 200 New motors from 2 HP—30 HP.

SLIP RING & SYNCHRONOUS

3 Phase, 60 Cycle, 220 or 440 Volt

(Other voltage as noted)

Qu	HP	Make	Type	Speed
1	443	El. M.	Syn.	900
1	300	G.E.	ATI Syn.	1800
1	200	F. M.	BV	600
1	100KW	G.E.	ATB Syn.	900
1	100	G.E.	I-16 2200 Volt	450
1	75	F. M.	BV 2200 Volt	1800
1	75	West.	(New) Syn.	1200
1	60	Ideal	AVX	1200
1	50	G.E.	I 25 Cycle	700
1	50	Al. Ch.		720
1	50	Ideal	AV 2200 Volt	600
1	40	G.E.	MT	1200
1	40	Al. Ch.		1200
1	40	G.E.	MT	900
2	40	West.	CW 2200 Volt	900
2	40	West.	CW	900
2	40	Al. Ch.		900
1	40	West.	CI	730
1	40	Burke	EMV7	1150/550
1	35	Al. Ch.		720
1	35	G.E.	I-12	600
1	30	Al. Ch.	2200 Volt	720
1	25	Cr. Wh.		1200
1	25	West.	CW	720
1	25	West.	MW	720
1	25	G.E.	MT Tot. Encl.	600
1	25	G.E.	MT	400

DC—230 Volt

Qu	HP	Make	Type	Speed
1	130	Cr. Wh.	CMC 550 Volt	1200
1	100	G.E.	CD	1200
1	100	West.	SK	1800
1	100	G.E.	RC38	600
1	100	G.E.	PC8 440 Volt	400
4	100	Cr. Wh.	CMC	225/550
1	75	Diehl	K11	700
1	60	West.	SK 115 Volt (Vert.)	1200
1	60	G.E.	EF1	1200
3	50	West.	SK	1200
1	40	Rel.	440 Volt B. B. Vert.	1800
1	40	Rel.	440 Volt B. B. (Vert.	1200/1800
1	25/40	Cr. Wh.	CMC 440 Volt (Vert.	1200/1800
1	40	Rel.	B. B.	400/1500
2	40	West.	SK	1200
1	40	G.E.	RC	1200
7	40	West.		775
1	35	G.E.	OMTEBB	1300
1	35	West.	SK	1200
1	35	Al. Ch.		1200
1	35	G.E.	DLC	700
2	30	El. Dy.	158	625/1250
5	30	Rel.	92TF	1800
1	30	Rel.	131T 440 Volt (Vert.)	1200
1	30	G.E.	RC	1200
1	30 KW	Al. Ch.	110 Volt	925
1	27½	G.E.	CVC116	1800
1	25	Cr. Wh.	CM 110 Volt	900/1200
1	25	Al. Ch.	E126	500/1500
1	25	Rel.	25P	250/1000
1	25	G.E.	RF	300/900
1	25	F. M.	IRC	400/800
6	25	West.	SK	1200
7	25	West.	SK	850
2	20	Rel.	131T	1000/2900
2	20	West.	SK	750/1500
1	20	Diehl	K9	500/1000
1	20	G.E.	CD	400/1800
1	20	G E.	RF	250/1000
1	20	Lincoln	FKW B. B.	1800
6	20	Cr. Wh.	CMC Enclosed	1800

DC—230 Volt

Qu	HP	Make	Type	Speed
1	20	Cr. Wh.	CMC TEBB (Exp.)	1200
1	20	Rel.	92T	1200
2	20	West.	SK	1200
1	20	West.	SK	900
1	20	G.E.	RC	900
7	20	West.	SK	750
1	20	West.	SK	600
1	15	West.	SK63	1800
1	15	West.	SK113 Encl.	1800
1	15	F. M.	D B. B.	1150
6	15	Rel.	66T	1150
2	15	Cr. Wh.	CCM	1150
1	15	Cr. Wh.	CCM Tot. Encl.	1500
1	15	West.	SK83	1150
2	15	West.	SK80L	1150
1	15	G.E.	CD	1150
1	15	West.	SK90	850
1	15	West.	K8 Crane	650
8	15	Rel.	92TF	850/1700
2	15	G.E.	CO Crane	650/2700
1	15	Rel.	131T 115 V.	600/1800
2	15	West.	SK	600/1200
1	15	Rel.	78T	400/1600
1	15	G.E.	RF11	400/1200
1	12½	West.	SK	750/1500
1	12	G.E.	RF	575/1725
1	10	West.	SK7	850/1700
2	10	G.E.	RF10	600/1800
1	10	West.	SK90	600/1800
7	10	West.	SK80L	500/1500
20	10	Al. Ch.		500/1000
1	10	Rel.	92TF	400/1600
1	10	West.	SK	250/1000
6	10	Cr. Wh.	CM TEBB	1800
1	10	Century	R304	1800
18	10	West.	SK	1150
2	10	West.	SK 115 Volt	1150
3	10	Rel.	46TF	1150
1	10	G.E.	RC9	1150
2	10	Rel.	66TF	850
2	10	G.E.	RC	850
3	10	West.	SK70	850
1	10	G.E.	RC29 550 Volt	850
1	10	Colonial		950
14	7½	West.	SK33	1750
4	7½	West.	SK60	850
20	5	West. & Gen. Elec.		1750
20	5	West. & Reliance		1150
35	5	West.	SK43	850

Hundreds of other DC motors not listed

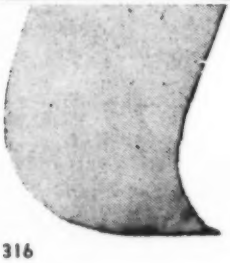
28 New vertical, T.E.F.C.B.B., 3 Ph, 60 Cy, 220/440 volt as follows:
1—Fairbanks-Morse, 3 HP, ty. QZCU, Fr. 254, 1200 RPM Exp.
2—General Electric 3 HP, ty. K, Fr. 254, 1200 RPM
6—General Electric 7½ HP, ty. K, Fr. 324, 1200 RPM
6—Delco, 7½ HP, type C, Fr. 324, 1200 RPM
1—Howell, 7½ HP, type KV, Fr. 284, 1800 RPM
6—General Electric, 15 HP, type K, Fr. 365, 1200 RPM
2—Howell, 15 HP, type KV, Fr. 365, 1200 RPM

1—New General Electric 250 HP, type KF, Frame 549A, 440 volt, 3 phase, 60 cycle, 3600 RPM vert., direct connected to Bingham type 2, 22 stage, double case, 3600 RPM, 3820 head, 175 GPM

21—New Allis Chalmers 200 HP, type ARZ, 2300 Volt, 3 phase, 60 cycle, 3600 RPM, totally enclosed, fan cooled, ball bearing

1—150 KW Westinghouse synchronous M-G set, 275 volt DC, 4400 volt AC, 3 phase, 60 cycle, 900 RPM, AC control & DC panel
1—150 KW General Electric M-G set 250/275 volt DC, 440 vol AC, 3 phase, 60 cycle, 900 RPM
1—100 KW Ridgeway synchronous M-G set, 250 volt DC, 2300 volt AC, 3 phase, 60 cycle, 1200 RPM AC control & DC panel
1—200 KW Burke synchronous M-G set, 750 volt DC, 440 volt AC, 3 phase, 60 cycle, 900 RPM with AC control & DC panel
1—30 KW Westinghouse M-G set, 125 volt DC, 2300 volt AC, 3 phase, 60 cycle, 900 RPM with AC control & DC panel

6—Practically new 40 KW Reliance & General Electric variable voltage M-G sets, 250 volt DC, 220/440 volt AC, 3 phase, 60 cycle, 1800 RPM, complete with exciters, all control and drive motors. All motors ball bearing, enclosed. M-G set, exciters and control mounted in fan cooled enclosure. Drive motor G. E. type CD, frame 1441, 40 HP, 230 volt 400/1600 RPM, enclosed, ball bearing, 50° Cont. 250 RPM, 1 hr. 50°

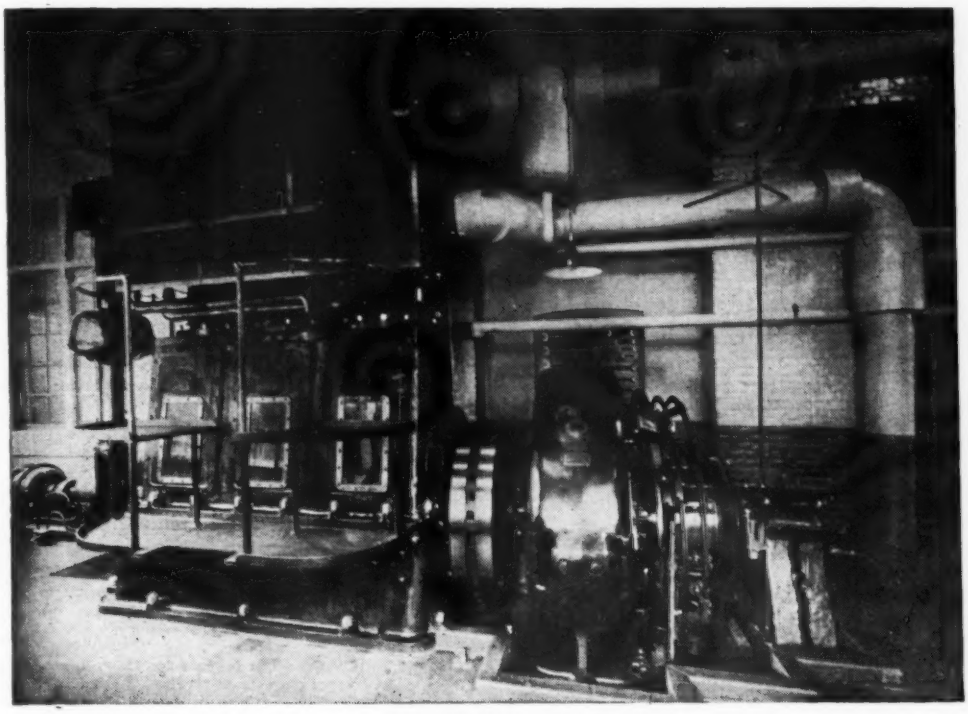


The Wente Electric Co.

Rebuilt Motors and Generators Since 1906

Hamilton PHONE HAMILTON 707 *Ohio*

400 KW DIRECT CURRENT SKINNER UNAFLOW ENGINE GENERATOR UNIT



Actual Photograph

400 KW maximum—325 KW, 35°C. Crocker-Wheeler 125 volt, 300 RPM interpole direct current generator direct connected to a 15" x 14", 3 cylinder, 300 RPM Skinner vertical Unaflow non-condensing engine, 125 to 150 lbs. pressure, 0 to 5 lbs. gauge back, complete with switchboard.

Excellent Condition

Complete Installation

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

3750 KVA G.E. 250# pressure, 4160 Volts, complete surface condenser, exciter.

2500 KVA Westinghouse condensing, 180 lbs. pressure, 2300 volts, complete surface condenser, exciter.

1875 KVA Westinghouse condensing, 175 to 200 lbs. pressure, 500°TT, 480 volts, complete.

625 KVA Westinghouse automatic bleeder condensing, 250 lbs. pressure, 20 lbs. gauge back, 480 volts, complete condenser and panel.

625 KVA G.E. condensing, 200 lbs. pressure, 2300 volts, complete exciter, condenser, switchboard.

625 KVA G.E. non-condensing 150 lbs. pressure, 15 lb. back, 2300 volts, complete exciter, panel.

125 KVA Westinghouse non-condensing, 175 to 200 lbs. pressure, 0-10 lbs. back, 240 volts, with exciter, panel.

125 KVA G.E. non-condensing, 175 lbs. pressure, 10 lbs. gauge back, 2300 volts, complete

100 KVA Westinghouse non-condensing 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts.

ENGINE-GENERATOR UNITS

Alternating Current

3 phase, 60 cycle

750 KVA G.E. 2300 volts, 150 RPM generator direct connected 28" x 32" Chuse Unaflow engine.

500 KVA Westinghouse, 460 volts, 164 RPM generator direct connected 26" x 28" Skinner Unaflow non-condensing engine, 140 to 160 lbs. pres.

312 KVA G.E. 480 volts, 180 RPM generator direct connected to 24" x 20" Skinner Universal Unaflow engine, 175 to 200 lbs. pressure.

225 KVA E.M. 2300 volts, 200 RPM generator direct connected 19" x 24" Chuse Unaflow poppet valve engine.

200 KVA Crocker-Wheeler, 240 volts, 400 RPM generator direct connected to Ames vertical Unaflow engine, 110 to 125 lbs. pressure, 5 lbs. gauge back.

180 KVA G.E. 240/440 or 550 volts, 200 RPM generator direct connected to 18" x 21" Chuse non-releasing Corliss engine, 125 to 140 lbs. pressure.

150 KVA G.E. 240 volts, 225 RPM generator direct connected to Ames Unaflow engine.

75 KVA Allis 2300/550 or 440 volts, 257 RPM generator direct connected to 12" x 16" Chuse 4-valve non-releasing Corliss engine.

ENGINE-GENERATOR UNITS

Direct Current

500 KW Crocker Wheeler 250 volt, 300 RPM direct connected Ames unaflow vertical non-condensing engine complete.

200 KW Burke 3-wire, 250 volt, 360 RPM generator direct connected Ames 4 cylinder vertical Unaflow non-condensing engine 150 lbs. pressure, complete switchboard.

75 KW Allis-Chalmers Terry, 125 volts, 2400 RPM 150 lbs. pressure non-condensing turbine generator unit.

35 KW G. E. 125 volt, 3600 RPM non-condensing turbine-generator unit.

15 KW Crocker-Wheeler, 125 volts, 410 RPM generator direct connected to an American Blower vertical engine.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2190 HP, 3 phase, 60 cycle, 4000/6600 volts synchronous motor.

100 KW G.E. 125 volts, 1200 RPM direct current generator direct connected 150 HP, 3 phase, 60 cycle, 220 volts induction motor.

62½ KVA G.E. 3 phase, 60 cycle, 2300 volts, 1200 RPM alternator direct connected 75 HP, 115 volt direct current motor.

50 KW Westinghouse, 125 volt, 1200 RPM direct current generator direct connected 75 HP, 3 phase, 60 cycle, 2300 volt induction motor.

SPECIAL BARGAIN OFFERINGS

5425 GPM Worthington 70' head, 1800 RPM centrifugal pump direct connected 125 HP G. E. 3 phase, 60 cycle, 2200 volt slip ring motor.

1200 KVA General Electric, 3 phase, 60 cycle, 2400 volts alternating current generator direct connected to 1700 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

187½ KVA Ideal 3 phase, 60 cycle, 240 volt, 400 RPM alternator direct connected 225 HP Buckeye Diesel.

500 KVA Westinghouse, 3 phase, 60 cycle, 600 volts, 514 RPM belted generator

MANISTEE ROTARY JET CONDENSER 7000 lbs. steam per hour, 28" vacuum direct connected to a 25 HP, 3 phase, 60 cycle, 220 volt, 900 RPM G.E. motor.

10 TON CAPACITY BROWN HAND OPERATED TRAVELING CRANE with 31'0" span including 150' of I-beams.

1—Allis-Chalmers jet condenser suitable for 2000 KW steam turbine-generator unit.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

LIQUIDATION SALE

(MOST EQUIPMENT 3 TO 4 YEARS OLD)

TURBO-GENERATORS

1—4600 KW G.E. 3 phase, 93 1-3 cycle, 2700 V, 5600 RPM (or 2900 KW, 60 cycle, 1700 V, at 3600 RPM), 410# cond., complete with 3800 sq. ft. condensers, amplidyne motor generators, circulating and condensate pumps, etc.

6—300 KW G.E. type ATI 3/60/450, 1200 RPM, cond., compl. with 40 KW exciters, condensers, switchboards.

1—500 KW 3/60/480, 3600 RPM, 185# press. cond.
8—200 KW, G.E. type ATB 3/60/450, 1200 RPM, cond.
2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.
2—375 KW West'hse 180/220 V, DC, 3000 Amp, 1200 RPM, cond.
1—300 KW 120/240 V, D.C. 1200 RPM
12—150 KW West'hse type SK, 120 V, DC, 1200 RPM, cond.
20—80 KW West'hse type SK, 120 V, DC, 1800 RPM cond.

NOTE — MANY GENERATORS FOR SALE SEPARATELY WITHOUT TURBINES

MOTORS

5—DC 25 HP, 35 HP, 50 HP, type CO 1808, 230 V, all variable speed 550 RPM to 2100 RPM
500—DC, from ½ HP to 80 HP, 120 V and 230 V, various speeds

18—General Electric AC synchr. motors, 3 phase, 6000 HP, 93 1-3 cycle, 2700 V, 400 RPM, or 3800 HP, 60 cycle 1700 V, 257 RPM

28—DC 1500 HP W'hse, 525 V, 600 RPM

MOTOR-GENERATORS

AC to DC and DC to AC—various sizes from 1 HP to 80 HP.

GENERATORS

28—1200 KW DC Allis Chalmers, 525 V, 750 RPM

BOILERS

2—Boilers, single pass., header-type, Babcock & Wilcox, built 1941, 22500# steam hr., at 250# press.
6—Express Boilers, modified D type, Foster Wheeler, 30,000# steam hr., 435# press., with economizers superheaters, desuperheaters, oil burners, etc.
2—Wickers Boiler 628 H.P. 3 drum. Navy Types, 250 pounds pressure.
6—Cyclotherm 3000 pounds steam per hour, 125# press.

BOILER FEED PUMPS, TURBINE DRIVEN

1—DeLaval 675 GPM 725# dischge., 4900 RPM, steam 540#
1—DeLaval 600 GPM 575# dischge., 4600 RPM, steam 400#
2—Worth'ton 750 GPM 375# dischge., 3500 RPM, steam 240#
1—Ing. Rand 165 GPM 575# dischge., 4650 RPM, steam 375#
3—DeLaval 125 GPM 575# dischge., 7000 RPM, steam 400#

CENTRIFUGAL PUMPS

60—Various sizes up to 15,000 GPM, up to 725# disch. pr. steel and bronze motor and turbine driven.

RECIPROCATING STEAM PUMPS

50—Simplex and duplex, various sizes, bronze and steel.

CENTRIFUGES

15—Sharples, 15—DeLaval } Oil purifiers and oil clarifiers capacity 100 GPH and 150 GPH, with motors and pump

HIGH PRESSURE COMPRESSORS

2—Ingersoll Rand type 40, 4 stage 3000# press., 20 cft. driven by G.E. 3/60/220/440 motors and 50 HP
1—Same, driven by Waukesha gas engine model GBZ 1111
2—Ingersoll Rand class B, 3 stage, 3000# press. 7½ cu. ft., driven by G.E. 3/60/440 motors, 24 HP

DISTILLING PLANTS

2—Griscom Russell Soloshell double effect, 8000 gals. per day, complete with pumps
3—Cleaver Brooks Co., 5000 gals. p. day, self contained units complete with boiler pumps and fans
2—Foster Wheeler 40,000 gallons per day, triple effect low pressure
1—Condenser Service 80 tons per day, double effect
1—Vapor compression distiller, Badger & Sons, 750 gals. cap.
10—Same, 2000 gals. cap.

CONDENSERS

4—7800 Square Feet—¾" brass tubes, two pas. (new).
10—3800 Square Feet—⅝" copper-nickel tubes (new).

AIR COOLERS — HEATERS

Single section, 2 pass, double tube type

10—1860 sq. ft. surface, Westinghouse
17—1670 sq. ft. surface, General Electric
7—1290 sq. ft. surface, Westinghouse

FOR COOLING

FOR AIR CONDITIONING

FOR DRYING

Each cooler consists of two headers carrying between them a group of fin tubes through which cold or hot water or steam is circulated while the air to be cooled or heated passes over the tubes.

Consider this feature for clean and safe operation:

These coolers are of the double tube type which eliminates spilling of water in case of leakage of inner tubes.

TURBO-BLOWERS

3—Sturtevant size 24—20,000 CFM at 17" S.P. turbine, 191 HP, 400# steam

SWITCHBOARDS

All sizes, AC and DC, whole or in parts, circuit breakers, current transformers, switches, meters, recorders, etc., etc.

TRANSFORMERS

5—50 KVA, 10—20 KVA, 10—25 KVA, 5—8 KVA } from 440 V to 120 V, all single phase, 60 cycle, dry type

HOISTS

2—Mead Morrison Co., 2 drum hoisting engines type H197, driven by 51 HP G.E. motor 230 V, DC
15—Bayard, driven by 28.35 H.P. gasoline engines (new)

FANS

150—From 3,000 to 16,000 CFM at 2" to 3" S.P. with AC and DC motors

FEED WATER HEATERS

FUEL OIL HEATERS

7—Blowers (Roots Connersville) size 16" x 18", connected to G.E. induction motor, 200 H.P., 3 phase 60 cycle, 2200 Volt, 705 RPM
2—Blowers (Roots Connersville) size 20" x 23" connected to Westinghouse Electric induction motor 350 H.P., 3 phase 60 cycle, 2200 Volt, 590 RPM

Blower Motors also sold separately.

WRITE OR CALL FOR DETAILS

HUGO NEU CORPORATION

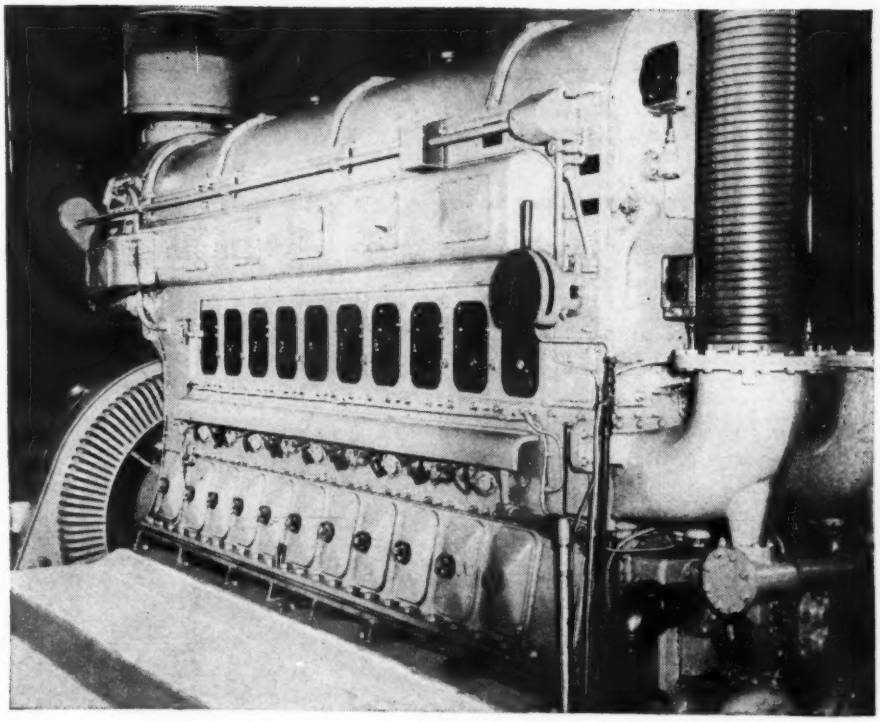
31 Nassau Street New York 5, N. Y.

Tel.: REctor 2-1334

ARRANGE FOR INSPECTION

AGSCO

—HEADQUARTERS FOR DIESEL GENERATORS



An AGSCO 1000 KW installation at ORILLIA, ONTARIO, CANADA

DIESEL GENERATORS A.C. 50 AND 60 CYCLE

KVA	MAKE	HP	MODEL	RPM	YEAR
1–1250	Nelseco	1500	6M1-53	300	1931
4–1250	Fairbanks Morse	1700	38D8⅛	720	1944
12–1250	General Motors	1600	16-278-A	720	1944
3–1000	Fairbanks Morse	1250	38D⅛	600	1944
1– 750	General Motors	900	12–567	720	1944
1– 625	Superior	750	OS	327	1938
1– 94	Buckeye	112	E	400	1936

Other units available from 100 to 1250 Kva

Write for Bulletins

DIESEL ENGINES

AG SCHOONMAKER CO INC.

50 CHURCH STREET NEW YORK 7, NEW YORK

Cable Address: AGSCOMACH PHONE: Digby 9-4350

Business Est. 1898

DIESEL POWER

NEW *Never Installed*

SURFACE CONDENSERS

ALSO NEW CONDENSER AUXILIARIES
Circulating and Condensate Pumps, Air Evactors, Etc., Etc.

WE CAN SAVE YOU: 33⅓% TO 75%

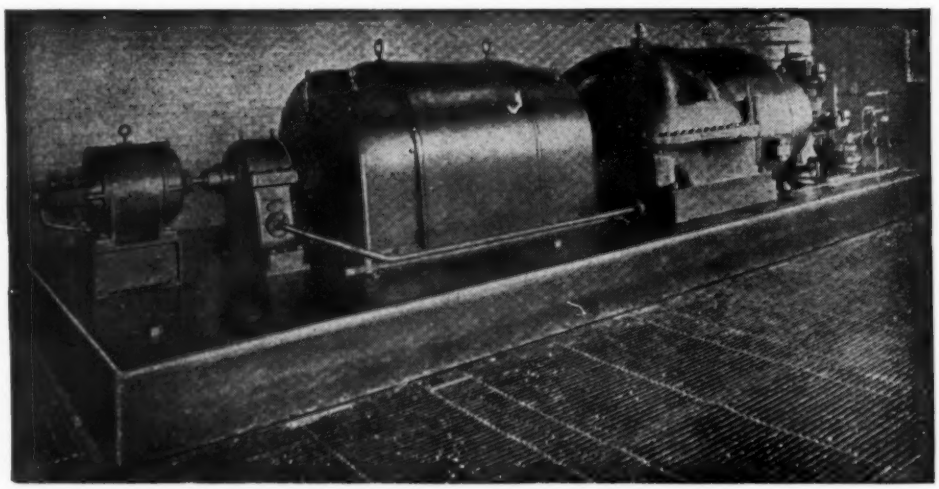
OUR RECENT OUTRIGHT PURCHASE OF MANY THOUSANDS OF DOLLARS ALSO INCLUDES NEARLY EVERY ITEM USED IN POWER PLANT OPERATION

SPECIAL: 3—450#, 720° F.TT. Turbine-Generators
1—5000—KVA., 2300-Volts
2—2850-KVA., 480-Volts

TURBO-GENERATORS

NEW & USED

IMMEDIATE DELIVERY



300#-psi., 550°F.TT., 2300-V., Modern 1875 KVA. Turbo-Generator.

USED TURBO-GENERATORS: Partial List Only of Our Stock

5000-KVA. 450#, 720°-F.TT., 2300-V.
7800-KVA. G.E. 250#, 2300-V., Sur. Condenser
5000-KVA. G.E. 200#, 100-Deg., 2300-V.
3750-KVA. G.E. 200#, 2300-V., Condensing
3125-KVA. West., 200#, 2300-V., (1-GE.)
2850-KVA. G.E., 450#, 720°-F.TT., 480-V.
2500-KVA. G.E., Aut. Extr., 200#-psi., 25#-B., 480-V.
1865-KVA. Elliott, 350#, 550-F.TT., 2300-V.
1865-KVA. G.E., Cond., 200#, 2300-V.
1865-KVA. G.E., Aut. Extr., 200#, 30#-Back, 2300-V.
1250-KVA. Allis-C. Non-Cond. 160#, 25-Back, 2300/
937-KVA. Moore-Allis, Non-Cond., 200#, 25#-Back
937-KVA. Allis-Chalmers Cond., 200#, 480-V.
625-KVA. West., Aut. Extr., 250#, 25#-Back, 480-V.
625-KVA. G.E., Non-Cond., 200#, 25#-Back, 2300-V.
500-KW., Several Good Units Available

Bulletins Nos. 205, 208, 249 — Free For the Asking: Write Today

CHARLES WEAVER & COMPANY

4045 Penobscot Building *ENGINEERS* Detroit 26, Michigan

AVAILABLE FOR IMMEDIATE SHIPMENT

UNIFLOW ENG. GEN. SET

1—300 kw Chuse vertical Uniflow engine generator set 6 cyl. 10 x 12 150# pressure O# B.P. 450 RPM direct connected to 300 kw G.E. Alternator 3-60-2300 v. with D.C. exciter 125 v. Excellent condition. Rebuilt 1945. Reasonably priced for quick sale.

SKINNER UNIFLOW SET

1—300 KVA Skinner Uniflow Engine Generator Set 150# ISP 0-5# BP direct connected to Burke Alternator 3-60-480 v. 200 RPM with Exciter and Control Panel.

TURBINE

1—710 H.P. Terry Turbine, type GF, 3531 RPM, complete with reduction gear to 1000 RPM, 145# pressure, 0.60# B.P.

AIR COMPRESSORS

1—Chicago Pneumatic Air Compressor, air cooled, 2 stage, 277 CFM displacement at 125 PSI with Receiver V-belted to 50 HP General Electric Motor 3-60-220-440 volt with control.

1—Ingersoll-Rand Compressor Type 40, 7" & 6¼" x 5" delivering 156 CFM at 100# with 40 HP Gen. Elec. TEFC motor, 3-60-220-440 volt, 900 RPM, Receiver and Control.

DIESEL ENGINES

1—150 H.P. Hercules 6 cyl., model DWXDS, 4¼ x 4¾.

3—68 H.P. Buda 6 cyl., model 6LD 468, size 4¼ x 5½.

AIR RECEIVERS

1—5' diam. x 14', Vertical.

1—6'2" diam. x 20'6", Vertical.

PUMPS

2—500 RPM, 360' head, Ingersoll Rand Centrifugal Pump, 1800 RPM.

1—4500 GPM, 135' head, LeCourtney Centrifugal Pump, 1800 RPM.

2—520 GPM, 50' head, DeLaval Centrifugal Pump, 1150 RPM.

5—Worthington, 2⅝" x 18" Horizontal Duplex Double Acting, cap. 133 GPM, 3500# W.P.

CARRIER AIR CONDITIONING UNIT

1—30 ton Carrier Air Conditioning Unit consisting of two—2 cylinder Compressors and two—15 HP Motors mounted on common base; with Kathabar Unit complete with all accessories, starters and instruments. Electrical characteristics 3-60-220-440. New 1942. Has been in use one season.

FLANGED GATE VALVES

Stainless Steel. Sizes 1" to 6".
Iron Body. Sizes 2" to 14".
Cast Steel. Sizes 2½" to 12".

NEW HOISTS

50 Yale & Towne 2 ton Chain Hoists. 20' lift. BRAND NEW in Original Packing.

MOTORS

1—200 H.P. G.E. Synchronous Motor 3/60/4150, 600 RPM with starting panel, V-Belted exciter. New 1943.

1—125 H.P. West. Squirrel Cage, 3-60-2200 v., 1800 RPM and Starter.

1—20 H.P. General Electric Induction Motor, 3-60-220 v. 1160 RPM.

3—Vertical Gear Head Motors, Crocker Wheeler TEFC 10 H.P., 220°440 Volt, 60 cycle, 3 phase, 1745 RPM. Philadelphia Gear, output 425 RPM.

TRANSFORMERS

1—7½ KVA G. E., 460/230-115 v.
1—10 KVA G.E., 2400-4160/240-480 v.
3—20 KVA West. 450-117 v. New.
6—25 KVA West., 450-117 v. New.
3—37½ KVA G. E., 4600/2300 v.
1—100 KVA West., type S, 4370-4160-3950/208-120 v. 3 Ph.
1—333 KVA West., type SL, 4160/480 v.
1—500 KVA West., type SL, 4160/480 v.

300 AND 400 AMPERE ELECTRIC MOTOR DRIVEN ARC WELDERS

Lincoln—Hobart—General Electric
Reconditioned—Guaranteed—New 1943

MISCELLANEOUS

1—3600 sq. ft. C. H. Wheeler Surface Condenser.
7—Buffalo Steel Plate Blowers, 40", type R, with Everdur Blades.

Heat and Power Co., inc.

70 PINE STREET | WHITEHALL 3-2172 | NEW YORK 5, N. Y.

for more than 40 years . . .

—A consistent policy of fair prices and full guarantee —has made WAGNER "Certified Rebuilt" MOTORS, GENERATORS, M-G SETS Pumps,—Fans,—Speed Reducers.

The CHOICE of MEN WHO KNOW!

M-G SETS

Others available—special units built to order

KW	Mfr.	Input V.	Output V.
200	Gen. Elec.*	220/440 AC	125 DC
150	Gen. Elec.	220/440 AC	125 DC
75	Cr. Wheeler*	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
40	Gen. Elec.	220/440 AC	250 DC
37½	Whse.	230 DC	3 ph. 240 AC
35	Gen. Elec.	220/440 AC	48 DC
30	Gen. Elec.	220/440 AC	125 DC
10	Marble Card	220/440 AC	60 DC

* Synchronous motor drive

D.C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
180	G. E. encl.	CL	230	800
100/150	G. E. dynamon.	TLC	250	1000/3500
100	Allis Ch.	E	115	650
80	Chand'son	D40	115	200/600
75	Whse.	813L	125	475
75	G.E.	BRC	115	1150
65	G.E.	C	230	375/750
60	G.E. b.b. (2)	CDM103	230	1750
50	Cr. Wheeler (2)	50H	230	700
60	Diehl dynamon.	R10	250	500/2000
35/50	G.E.	CD123	230	575/1150
50	Whse. b.b.	SK133	230	1150
45	P & H crane (2)	14X	500	440
40	Gen Elec. (2)	RC32	230	1150
30	Whse.	S-7	115	900
25	Chand'son (4)	C13	115	850
25	Roth	RS	230	1750
25	G.E.	DLC	230	750
25	G.E. b.b. New	CDM93	115	1150
20	G.E. b.b. New(2)	CDM83	115	1750
20	Imp. int. dty.	D37	230	1200
20	Reliance	T	230	850
20	G.E.	LC	230	575
20	G.E.	DLC	230	500/1500
20	P & H crane	10½X	500	625
20	Gen. Elec.	RC11	115	1150
20	Gen. Elec.	RCP29	230	1750
15	Gen. Elec.	RC10	115	1150
15	G.E. b.b. New(2)	CDM67	115	1750
15	G.E.	RC29	230	1700
15	Roth	RS	230	1750
15	G.E. b.b. New	CD83	230	1200
15	Whse. New	SK83	230	1150
15	G.E.	RC10	230	1150
15	Whse. (6)	SK90	230	825
15	L. Allis b.b.	ONW444	230	575/1725
15	G.E.	LC	230	550
10	Marble Card	b.b.	230	3450
10	G.E.	CD73	230	1750
10	Allis Ch. (5)	E80	230	1150
10	G.E. b.b. New(2)	CDM66	115	1750
10	Whse. crane	K-4	230	1070
10	Whse. b.b.	SK83	230	850
10	G.E.	CD83	230	850
10	Star b.b. New(2)	SQ20	230	900
10	Whse.	SK90	230	600
10	Whse. (2)	SK80L	230	500/1000
10	Reliance b.b.	92T	230	450/1800
10	G.E.	RF	230	400/1600

D.C. GENERATORS

KW	Mfg.	Type	Volts	Speed
300	G.E. 1 brg.	MPC	125/170	1150
150	G.E.	CL	250	900
100	G.E.	TLC	250	1100
85	Allis Ch.	E	125	750
75	Whse.	S	125	600
70	Whse.	813L	250	575
50	Cr. Wheeler (2)	CCD	250	850
40	Gen. Elec.	RC32	250	1250
30	Lincoln b.b. 600 amp.		50	1200
24	Whse.	SK	600	850
25	G.E. b.b. New	CD93	125	1450
20	Allis Ch.		125	475
15	Imperial	HV	250	1450
12½	Engberg b.b.	MR	250	1150

SPECIAL BARGAINS

Centrifugal pumps up to 10 inch. Fans & blowers, all sizes, new & used. Oilgear pressure pumps, 100 gpm, 1100 #. Coolant pumps & rotary gear pumps.

A.C. MOTORS—SLIP RING

3 phase 60 cycle 220 or 440 volts

Qu.	H.P.	Mfr.	Type	Speed
1	400	G.E. 3 brg.	I-P	450
1	300	G.E. 2200 v.	I-M	1800
1	200	G.E.	IM-E13B	1800
1	200	G.E.	IM-E15	1200
1	200	Whse. 3 brg.	HP	600
1	100	Whse.	CW761C	1800
1	75	Whse.	CW	1200
1	75	G.E. b.b.	MT	1200
1	75	Whse.	HF	720
1	60	G.E.	MT	1200
1	40	Allis Ch.	ARY	1200
1	40	Whse.	CW	900
1	40	Allis Ch.	ANY	450
2	37	G.E. int. duty	ITC	1200
1	37	G.E. int. duty	ITC	600
1	35	Lancashire	b.b.	1800
1	30	G.E.	OMT336	1200
1	30	Whse. int. duty	CI	900
1	30	Allis Ch.	ARY	1200
1	30	G.E.	MT346	600
1	25	Triumph	SR	1200
1	25	G.E.	I-M	900
1	20	P & H int. b.b.	WT8	1200
1	15	P & H int. b.b.	W-7	1200
1	15	G.E.	I-M	900
1	15	Watson	KHV	720
2	10	Century New b.b.	SRT326	1200

A.C. MOTORS—SQUIRREL CAGE

3 phase 60 cycle 220 or 440 volts

Qu.	H.P.	Mfr.	Type	Speed
1	400	G.E. 2200 v.	I-K	1800
1	250	G.E. 2200 v.	I-K	600
2	150	F. Morse	B	600
1	150	Gen. Elec.	I-E13A	1800
1	150	F. Morse	H	1200
1	125	Cont. 2200 v.	SC	1800
1	125	Northwn.	H	1800
1	125	Cr. Wheeler	125Q	900
1	100	G.E.	I-K	600
1	100	Whse. vertical	CS	1200
1	75	G.E.	KT329Y	3600
1	75	G.E. 2200 v.	I-K	514
1	60	Howell b.b.	SC	1800
8	60	G.E.	K505	1200
1	60	Ideal	A306	1200
1	60	G.E.	KT346	900
2	50	G.E.	I-K	1200
2	50	G.E.	I-K	900
1	50	G.E.	KT342	900
1	50	Reliance b.b.	AA	720
2	50	Whse. vertical	CS766	900
1	40	G.E.	I-K	1200
1	30	Delco New	TEFC	1200
2	30	Gen. Elec.	KT526	1200
3	15	Reliance b.b.	B326	1800

SPECIAL

SPECIAL—15 HP Gearhead Motors

Gen. Elec. K326 b.b. 3/60/220/440 V. output 234 RPM, like new.

▼

Also many speed reducers & gear motors in stock up to 15 H.P., new & rebuilt, at various speeds, A. C. & D. C.

A.C. MOTORS—SQUIRREL CAGE

Qu.	H.P.	Mfr.	Type	Speed
2	40	G.E.	I-K	900
1	40	Allis Ch. 3 spd.	ARX	900/600/450
1	40	Whse.	CCL	720
2	35	G.E.	I-K	720
2	30	Howell b.b. 4 spd.	SC	1800
1	30	Whse. New b.b.	CS405	1200
1	30	F. Morse	BH	600
2	25	Whse. New spl. b.b.	CS365	1800
2	25	U. S. b.b. New	SC364	1800
1	25	G.E.	I-K	1200
1	25	Whse. New splprf.	CS405	1200
8	25	Whse.	CS586C	900
1	25	G.E.	KT526	900
2	25	G.E.	I-K	600
2	20	U. S. New b.b.	SC326	3600
1	20	G.E.	KT182	3600
2	20	Whse. New TEFC	CS364	1800
2	20	Delco New TEFC	C364	1800
3	20	Whse. New splprf.	CS364	1800
2	20	Century 4 spd. b.b.	SC504	1800
2	20	G.E.	I-K	1200
1	20	F. Morse	BH12B	900
2	20	G.E.	I-K	720
1	20	Whse. vertical	CS	1200
4	15	G.E. New b.b.	K324	3600
4	15	Whse. New b.b.	CS326	1800
2	15	Whse. New b.b.	CS364	1200
1	15	F. Morse vertical	Q326	1800
3	15	G.E. splprf. b.b.	K365	1200
2	15	Whse. b.b.	CS365	1200
5	15	G.E.	KT302	1200
3	15	Whse. TEFC b.b.	CS365	1200
2	15	G.E.	KT512	900
1	15	Allis Ch.	AR217	720
1	15	G.E.	I-K	720

A.C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
300	G.E.	ATI	220/440	600
300	El. Machy.	late	2200	360
225	KVA-G.E.	ATI	220/440	900
225	Elec. Machy.	3 brg.	440	600
125	Whse.	G	220/440	900
125	G.E. spl. New	TS955	220/440	1200
125	Whse.	G	2200	900
100	KVA-Cr. Wheeler		220/440	900
75	El. Machy.	BRKT	550	900
60	El. Machy.	BRKT	220/440	1200

A.C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Speed
450	Whse. 2200 v.	CW slipring	750
150	Whse.	HF slipring	500
150	Whse.	C sq. cage	500
100	Whse.	CCL sq. cage	500
100	Fair.Morse 550v.	H sq. cg.	750
50	Allis Ch.	ANY slipring	1500
50	G.E. int.	MTC-5537	750
25	Whse. (4)	C sq. cage	750
20	Whse. (5)	C sq. cage	750
15	Whse. (3)	C sq. cage	750

A.C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	G.E.	ATB	2300	450
500	G.E.	ATB	2300	450
250	G.E.	ATB	240/480	600
225	G.E.	ATB	240/480	900
200	G.E.	ATB	240/480	600
150	Allis Ch.	B	2300	900
150	Allis Ch. 25 cycle	B	240/480	500
100	Whse.	G	2300	900
100	Whse.	G	240/480	900
100	Cr. Wheeler	10388	240/480	900
100	Cr. Wheeler		240/480	600
75	Triumph	A15L	240/480	900
50	Cont. b.b.	S107	120/208	1200
25	Whse. b.b. like new 1 phase		120	900

ARTHUR WAGNER COMPANY

1436-38 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 7409

LIQUIDATION SALE

DIESEL ENGINES

	Make	Model	H.P.	R.P.M.	Cycle	Cylinders	Bore & Stroke	Year	Reverse & Reduction Gear
4	General Motors	16-258S	1800	900	4	16	9½″×12″	1943	2.41:1 (fluid coupling)
2	Hamilton	R.B.99-D.A.	1600	700	2	9	9 1/6″×13⅜″	1944	
2	General Motors	12-278A	1200	750	2	12	8¾″×10½″	1944	Falk 2.5:1
22	General Motors	12-567ATL	900	744	2	12	8½″×10″	1942-44	Falk 2.5:1
2	General Motors	8-268A	500	1200	2	8	6½″×7″	1943	2.54:1
2	Superior	Type VDMB	350	600	4	8	9″×12″	1939	
2	Fairbanks Morse	38 O/P	300	1200	2	6	5″×6″	1936	

A. C. DIESEL GENERATOR SETS

									KW	Volts	Cycles	Phase	Make of Generator	DC Generator KW	DC Generator Volt
3	General Motors	8-268A	400	1200	2	8	6½″×7″	1943	200	440	60	3	Westinghouse	40	120/240
1	General Motors	3-268A	150	1200	2	3	6½″×7″		100	440	60	3	Westinghouse	2	120

D. C. DIESEL GENERATOR SETS

7	General Motors	16-278A	1600	750	2	16	8¾″×10½″	1943	1200	525 DC	Allis Chalmers Type MHC 2290 AMPS
2	General Motors	8-268A	500	1200	2	8	6½″×7″	1944	375	120/180/240 DC	Westinghouse
24	Superior	GDB-8	150	1200	4	8	5½″×7″	1942-44	100	120/240 DC	Delco Model T362 3 wire stab. shunt 60° C rise 417 AMPS
12	General Motors	3-268A	150	1200	2	3	6½″×7″	1943-44	100	120/240 DC	Allis Chalmers
2	General Motors	6-71	90	1200	2	6	4½″×5″	1943	60	120 DC	General Electric
1	Buda	6DCG844	110	1200	4	8	5¼″×6½″	1944	60	120 DC	General Electric
2	Fairbanks Morse	36A5½DE	100	1000	4	6	5½″×7½″	1943	60	225 DC	Fairbanks Morse Type DGZH compd. wd. 267 AMPS
1	Caterpillar	D3400	26	1500	4	4	3¾″×5″	1942	15	120/240 DC	General Electric Model 52A1990 compd. wd.

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HUGO NEU CORPORATION

31 Nassau Street *Tel.: REctor 2-1334* **New York 5, N. Y.**

ARRANGE FOR INSPECTION

THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.

2—6250 KW Gen. Elec. Cond. 25 Cycle
1—5000 KVA General Electric Cond.
1—4000 KW General Electric Cond.
2—3750 KVA Westinghouse Cond.
1—3750 KVA Westinghouse Extrac.
1—3125 KVA General Electric Cond.
2—3125 KVA General Electric Extrac.
2—1250 KVA General Electric Cond.
2—1250 KVA Elliott Cond.
1— 225 KVA General Electric Non-C.

STEAM ENGINE UNITS—60 Cy.

1—900 KW Hamilton Uniflow
1—750 KVA Chuse Uniflow
1—500 KVA Chuse Uniflow
1—450 KVA Ames Uniflow
1—375 KVA Harrisburg Uniflow
1—325 KVA Skinner Uniflow
1—312 KVA Ames Uniflow
1—300 KVA Skinner Uniflow
1—225 KVA Skinner Uniflow
1—150 KVA Harrisburg 4-valve
1—125 KVA Ames Uniflow

D. C. STEAM ENGINE UNITS

1—600 KW Ames Uniflow, 250 V.
1—500 KW Ames Uniflow, 250 V.
1—400 KW Ames Uniflow, 250 V.
1—350 KW Ridgway Uniflow, 250 V.
1—300 KW Skinner Uniflow, 275 V.
1—275 KW Ames Uniflow, 250 V.

DIESEL ENGINE UNITS

2—1600 HP Gen. Motors, 2400 V. 60 cy. gen.
1— 750 HP Worthington, 250 V., 60 cy. gen.
1— 750 HP Cooper Bessemer, 460 V., 60 cy. gen.
4— 720 HP Amer. Loco., 240 V. DC.
1— 625 HP Worthington, 240 V., 60 cy. gen.
1— 500 HP Gen. Motors, 480-2400 V. gen.
1— 300 KW Buckeye, 450 V. 60 cy. gen.
2— 30 KW Buda 6DTG-317, 3-60-127/220 V.

WATER TUBE BOILERS

1—1409 HP, B. & W., 650-lb. Stoker
2— 748 HP Edgemoor 250-lb. Stokers
2— 560 HP Erie City 460 lb.
1— 519 HP Titusville 200-lb. Stoker
5— 492 HP Heine, 180-lb. Stokers
2— 469 HP B. & W. 425-lb. Pulverizor

SYNCHRONOUS MOTORS

4—6000 HP G. E. 60 cy. 2300 V. 90 RPM
1— 500 HP G. E. 60 cy. 2300 V. 257 RPM
1— 300 HP G. E. 60 cy. 2200 V. 600 RPM
1— 300 HP G. E. 60 cy. 2200 V. 600 RPM
1— 300 HP West. 60 cy. 2300 V. 900 RPM
3— 150 HP West. 60 cy. 2300 V. 450 RPM
1— 100 HP G. E. 2300 V. 240 RPM (Super)

INDUCTION MOTORS

1—1000 HP West. S/R, 2200 V. 360 RPM
1— 200 HP G.E. S/C 2300 V. 1800 RPM
2— 150 HP Burke S/C 440 V. 1800 RPM, New.
1— 150 HP G.E. S/C 440 V. 600 RPM
1— 150 HP G.E. S/C 2300 V. 1800 RPM
2— 120 HP G.E. S/C 220 V. 3600 RPM

MOTOR GENERATOR SETS

1—1500 KW Allis Chal. 600 V. DC, 60 cy.
1— 500 KW Cr. Wh. 600 V. DC, 60 cy.
1— 400 KW Cr. Wh. 275 V. DC, 60 cy.
1— 400 KW Allis Chal.. 275 V. DC, 25 cy.
2— 300 KW Allis Chal.. 275 V. DC, 25 cy.
1— 300 KW Westinghouse 250 V. DC, 60 cy.
1— 250 KW Allis Chal., 275 V. DC, 25 cy.
2— 225 KW Gen. Elec. 115 V. DC, 60 cy.
1— 75 KW Westinghouse 125 V., DC, 60 cy.
1— 50 KW Westinghouse 125 V., DC, 60 cy.

ROTARIES—60 Cy.

1—2000 KW Allis Chalmers 600 V.
1—1000 KW Allis Chalmers 600 V.
1— 750 KW Westinghouse 275 V.
1— 750 KW General Electric 600 V.
1— 500 KW General Electric 275 V.

FREQUENCY CHANGERS

1—2150 KVA G. E. 25/62½ cy. 750 RPM
1—1875 KVA G. E. 25/60 cy. 300 RPM
1—1200 KVA G. E. 25/60 cy. 300 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1— 938 KVA West. 25/62½ cy. 750 RPM
1— 600 KVA G. E. 60/25 cy. 300 RPM

TRANSFORMERS—60 Cy.

2— 2000 KVA West. 69/34.5-4.8/2.4 KV
4— 333 KVA Al Ch. 25410/44000-13200/23000Y V.
1—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
1— 1000 KVA G. E. 24000-11500 V. 3 ph.
2— 1000 KVA G. E. 23000/11500-575 V.
1— 3750/5000 KVA West. 22000/460 V. 3 ph.
1— 3000 KVA Kuhlman 13800-240 V. 3 ph.
2—10000 KVA Pittsburgh 13200-4600 V. 3 ph.
2— 1000 KVA G.E. 11500/23000-575 V.
2— 2500 KVA Penn. 4150/2400-480 V.—3 ph.
1— 1500 KVA Al. Ch. 2400-480 V.—3 ph.
3— 250 KVA Moloney 2300-240/480

OIL CIRCUIT BREAKERS

1— 400 A. 37 KV West. GII	Outdoor
2— 400 A. 25 KV G. E. FKO136	Outdoor
2—1000 A. 23 KV Kelman CB76	Outdoor
6— 600 A. 15 KV G. E. FK255	Indoor
4— 600 A. 15 KV G. E. FHKO139-24B8	Outdoor
1— 600 A. 15 KV G. E. FKO37	Pole type
2— 400 A. 15 KV G. E. FHKO136	Outdoor

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Special Offerings

TURBO-GENERATORS

3— 3,000 KW 600 V Cond.
1— 2000 KW 600 V Cond.
1— 2000 KW 480 V N.C.
2— 1500 KW 2300 V Cond.
1— 1250 KW 2300 V. Cond.
1— 1000 KW 440 V. Extrac.
1— 1000 KW 2300 V Cond.
1— 750 KW 240 V Extrac.
2— 500 KW 600 V Cond.
1— 500 KW 240 V Cond.
1— 250 KW 240 V N. D.
1— 125 KW 600 V Extrac.
1— 50 KW 220 V AC, N.C.

ENGINE GENERATORS

2—600 KW. 2300 V. Uniflow
1—168 KW. 600 V.
1—280 KW. 480 V.
1—250 KW. 480 V.
1—150 KW. 480 V.
1—125 KW. 125/250 V.D.C. Uniflow

TURBINES ONLY

1—375 H.P. with gears
1—210 H.P. Terry 250#

BOILERS

1—90,000# 550 PSI
1—50,000# 250 PSI
1—30,000# 425 PSI
2—507 HP 160#
1—500 HP 400#
1—460 HP 250#
1—200 HP 160# HRT
1—150 HP 150# HRT
1— 75 HP 150# NEW

AIR COMPRESSORS

1—6000 CFM 50# Motor
1—1573 CFM 100# Motor
1—1300 CFM 50# Steam
1—1700 CFM 100# Steam
1—5000 CFM 10# G. Rotary Type Driven by 440V. Syn. Motor.

TRANSFORMERS

3—200 KVA 600/220/110

MOTOR GENERATORS

1—100 KW 550/125V

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The Buyer Must Be Satisfied—Always

SYNCH. CONVERTERS

500 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM. 6 PH. CY. SWITCHGEAR AND TRANSFORMERS.

300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM. 6 PH. 60 CY. SWITCHGEAR AND TRANSFORMERS.

300 KW G.E. 600 D.C. 11500/13200 A.C. 1200 RPM. 6 PH. 60 CY. COMPLETE FULL AUTOMATIC G.E. SWITCHGEAR.

MOTOR GENERATORS

500 KW G.E. SYN. 600 V. 2200/4000 A.C. 1200 RPM, 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

300 KW RIDGWAY SYN. 250 V. 2200 A.C. 1200 RPM, 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

300 KW. A.C. IND. 250 V. 2300 A.C. 1200 RPM. 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

200 KW G.E. SYN. 250 V. 2300 A.C. 720 RPM. 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

150 KW G.E. SYN. 250 V. 2300 A.C. 1200 RPM. 3 PH. 60 CY. COMPLETE MANUAL SWITCHGEAR.

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NEW SURFACE CONDENSERS

3—Surface Condensers 9500 sq. ft.
2—Surface Condensers 7900 sq. ft.
2—Surface Condensers 8200 sq. ft.
1—Surface Condenser 6300 sq. ft.
3—Surface Condensers 3300 sq. ft.
4—Surface Condensers 2200 sq. ft.
2—Surface Condensers 1500 sq. ft.
8—Surface Condensers 600 sq. ft.

HEATERS

5—Deaerating Feed Water Heaters, capacities 40,000 to 90,000# per hour. NEW.

STEAM TURBINES

1—5000 KVA 3 Ph. 60 Cycle 2300 Volt 440# late model G. E. Bleeder Type Turbine with auxiliaries.
2—750 KW G. E. 480 Volt Condensing Turbines.
1—200 KW Slightly Used 3 Ph. 60 Cycle 440 V. G. E. Condensing Turbine, 400# Pressure.
1—800 HP Westinghouse 4883 RPM, 535# PSI, 2 bearing.

TURBINES

1—275 HP G. E. Curtis Horizontal Turbine, 3600 RPM, 120# Pressure Condensing.
8—115 HP G. E. Horizontal Turbines, 4000 RPM, 435# Pressure, 10# B. P. NEW.
2—19 HP Terry, 18" Wheel, 1860 RPM, 235# Pressure, 10# B. P. NEW.

AIR EJECTORS — NEW

5—Air Ejectors, New Twin, 2-Stage, for 8000 KW Turbine.
6—Air Ejectors, Twin, 2-Stage, New with inter and after Condensers for 6000 KW Turbines.
3—Air Ejectors, Twin, 2 Stage, New. With inter and after Condensers, for 500 KW Turbines.
3—Air Ejectors, Twin, 2-Stage, New with inter and after Condensers, for 4000 KW Turbines.

EVAPORATORS—NEW

4—80,000# fresh or 40,000# salt water per 24 hr. day capacity Renauld Evaporators. Manifold cast bronze. Coiler SD copper tubing. NEW.
5—Paracoil-Davis, 90" high x 56" dia.

BLOWERS—NEW

2—82,000 CFM forced draft blowers driven by 253 HP steam turbines.
5—19,000 CFM at 10.8" Buffalo forced draft blowers, Type SL, Size 6-82 with control vanes. Direct connected to 50 HP, 3 ph. 60 cycle, 440 volt motor, variable speeds and capacities. (4 clockwise and 1 counter-clock)
2—15,930 CFM forced draft blowers driven by 30 HP motors.
3—5500 CFM forced draft blowers, steam turbine driven.

CIRCULATING PUMPS—NEW

3—3000 GPM Dayton-Dowd, vertical, centrifugal, split case, circulating pumps, 24.5' head Direct connected to 25 HP 230 V, DC, 656/875 RPM ball bearing motors.
2—Circulating Pumps, 13,000 GPM.
6—Circulating Pumps, Main, 10,500 GPM.

BOILER FEED PUMPS

8—470 GPM, De Laval, horizontal, centrifugal, 750 PSI discharge head, 5140 RPM. Powered by 320 HP, De Laval steam turbines, 2-stage 575# max. steam pressure.
3—200 GPM, Pacific, Size 2"S, horizontal, split case, 4 stage, centrifugal, 1380' head, 4" suction, 2" discharge, 4000 RPM. Direct connected to 115 HP, 4000 RPM, G. E. turbine, 435 PSI steam pressure, NEW.
9—200 GPM, Ingersoll Rand, 6-Stage, horizontal, 800# pressure, 1465' dynamic head, bronze impeller, 2½" suction, 1½" discharge. Direct connected to 125 HP, steam turbine, 150# pressure, 4125 RPM.
2—150 GPM, Pacific pumps, horizontal, centrifugal multi-stage, split case, 525# press., 1282' head, bronze impellers, 2" suction, 4" discharge. Direct connected to 110 HP, Westinghouse turbines, 4050 RPM, 440# max. steam pressure.
4—157 GPM, 12 x 8 x 24 Worthington, vertical, simplex steam pumps, 600# discharge pressure, 300# max. steam pressure, bronze fitted, 5" suction, 4" discharge.

CONDENSATE PUMPS—NEW

24—14 GPM, Goulds, horizontal, single stage 143' head, bronze impellers, 1½" suction. 1" discharge, close coupled to 2 HP, 230 volts, 3500 RPM. Reliance DC motors with magnetic push button marine type controllers.

POWER PUMPS

1—Gardner Denver, horizontal duplex power pump, max. working pressure 1600#, max. speed 65., 4" suction, 3" discharge. NEW.
4—1-3/16 x 1-11/16, Deming, horizontal duplex, double acting, 10 GPM, suction lift 12', max. discharge pressure 120#, suction 1½", discharge 1". V-Belt driven by ¾ HP Peerless 230 Volt, 1750 RPM, Cpd. wound motors.

SIMPLEX STEAM PUMPS—NEW

5—14" x 11" x 18" Worthington vertical simplex steam pumps. 400 GPM, 125# discharge pressure, 140# max. steam pressure, 10# suction, 8" discharge.
2—12" x 14" x 18" Worthington vertical simplex steam pumps. 600 GPM, 50# discharge pressure, 140# max. steam pressure, 10# suction, 8" discharge.

DUPLEX STEAM PUMPS—NEW

13—7½" x 9" x 12" Worthington design vertical duplex steam pumps, 325 GPM, 230# steam pressure, 15# back pressure, 6" suction, 5" discharge.

FUEL AND LUBE OIL PUMPS—NEW

3—10" x 11" x 18" Worthington vertical simplex lube oil pumps, 325 GPM, 50# discharge pressure, 8" suction and discharge, 140# max. steam pressure.
5—225/325 GPM, De Laval, IMO, lube oil service pumps, 45# pressure, vertical. Direct connected to 15 HP 230 Volt, 950/1750 RPM Reliance DC ball bearing motors. NEW.
4—22 GPM, Kinney "Heliquad" horizontal rotary fuel oil pumps, Size 42-181, 325' head 20' suction lift. Direct connected 10 HP, 230 V G. E. DC motors through 4.15:1 reduction gear with speed regulating rheostat controllers.

FEED WATER REGULATORS—NEW

8—Hammel-Dahl Feed Water Regulators, remote control of liquid level for feed water heaters.

STEAM TURBO-GENERATORS, A. C.

6—312 KVA, Westinghouse, 1200 RPM (thru gears) 3 ph. 60 cyc. 440 V, 440# Pressure, NEW.
2—100 KW General Electric, 125 KVA, 4 wire, 3 Ph. 60 cyc. 240/110 V, 3600 RPM. Turbine 150/200 PSI.

STEAM TURBO-GENERATORS, D. C.

6—300 KW Westinghouse, 3 wire, 120/240 V, 1200 RPM, Turbine Condensing, 400 PSI, geared, NEW.
1—290 KW Westinghouse 120/240 V, 1200 RPM Geared to turbine, 200# pressure, 4410 RPM, NEW.
1—50 KW Sturtevant, 125 V, 2800 RPM Turbine 150# Pressure.
1—35 KW G. E. 115 V. 3400 RPM Turbine 125# Pressure.
2—25 KW, Westinghouse, 125 V, geared to 7260 RPM. Turbine, 200# pressure.

STEAM ENGINE DRIVEN UNITS

3—20 KW Marine Electric Co. Generators; 120 V, 500 RPM, compound wound, powered by Gault vertical steam engine. NEW.

BOILERS—NEW

2—1500 HP 3 Drum B&W 300#, with superheaters, new and unerected, 150,000# Steam, with oil burners, casing, erection steel, soot blowers and safety valves. Built in 1943. Fine self-contained units.
3—1000 HP Combustion Engineering Co. 105,000# Steam, 300# pressure, with steel and casing, soot blowers, oil burners and safety valves.
10—600 HP, 440# Combustion Engineering Co. 49,000# Steam, superheaters, oil burners and trim.
2—500 HP, Combustion Engineering Co. Cross Drum, Sectional header, 440#, 750° T. T., oil burning.

D. C. GENERATORS & M. G. SETS

6—300 KW NEW Westinghouse DC 240 Volts 1200 RPM, 3 wire Generators. Can also offer same with 321 KVA 3 ph. 60 cyc. 440 Volt NEW Westinghouse Synchronous MOTORS.

CIRCUIT BREAKERS

10—2000 amp. 500 Volt AC 3 pole latest type G. E. Circuit Breakers. NEW.
2—5000 amp 500 Volt AC 3 pole G. E. solenoid operated Oil Circuit Breakers.

MOTORS—DC—NEW

6—765 HP G. E. 2 Bearing 500 Volt DC 1030/1300 RPM.

STEAM DIESEL AND GAS ELECTRIC POWER UNITS

DIESEL ENGINES

2—950 HP Cooper-Bessemer, 300 RPM, 8 cylinder, 4 cyc. solid injection. UNUSED.
3—448 HP Baldwin, 4 cyc. 400 RPM. UNUSED.

DIESEL ELECTRIC POWER UNITS

3—290 KW, 240 V, Direct current, Generators, shunt wound, 1200 RPM (2 Westinghouse, 1 General Electric)
Direct connected to 500 BHP Gen. Motors, 8-cylinder Diesels, Model 8-268A.
If AC Generators required, we have available: 1 NEW, 2 Slightly used.
3—250 KW, 315 KVA, .80 PF, 1200 RPM Alternators 3 Ph. 60 Cyc. 450 V., 400 A. with 5.5 KW 1200 RPM shunt wound direct mounted Exciters. NEW. With used General Motors Diesels.
6—30 KW 3 Ph. Diesel Driven Power Units, Buda, NEW.

GAS ELECTRIC LIGHTING UNITS, AC

16—15 KW, 18.75 KVA Kato Generators, 3 ph. 60 cyc. 4 wire, 127/220 Volts, 1800 RPM, direct connected to Chrysler 6-cylinder engines. NEW.
24—10 KW, O'Keefe & Merritt Power Units, Single phase, 60 cyc., 120/240 Volt, 4 wire, 1800 RPM with 4-cylinder gas engine. NEW.
16—7.2 KVA, 5 KW, .7 PF Onan, 110 V, single phase, 60 cycle. NEW.

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MOTORS — M-G SETS — TRANSFORMERS

NEW MOTORS

3 ph. 60 cy.

Qn.	H.P.	Make	Volts	Speed	Type
60	1	Peerless B. Brg.	220/440	1800	P188
5	2	West. T. E. F. C. B. B.	220/440	1800	C8P-224
2	2	Dayton B. Brg.	220/440	1200	225
2	2	B-Line B. Brg.	220/440	1800	224
3	2	Dayton B. Brg.	220/440	1800	224
3	3	Dayton B. Brg.	220/440	1800	225
4	3	West. T.E.F.C. B. B.	220/440	1800	225
1	3	West.	220/440	1800	CSP-225
2	3	West.	220/440	1200	CS-254
2	3	Brown & Brock.	220/440	1800	225
10	5	West. B. Brg.	220/440	1800	CSP-254
1	5	West.	220/440	1200	CSP-254
5	7½	West. T. E. F. C. B. B.	220/440	1800	CSP-284
5	10	West. T. E. F. C. B. B.	220/440	1800	CSP-324
1	15	G.E. B. Brg.	220/440	1800	K-326

1 ph. 60 cy.

2	1½	G.E. Exp. Pro.	115/230	1800	SCR-224
5	1	B-Line	115/230	1800	RM-203
11	¾	B-Line	115/230	1800	RS-720-R

TRANSFORMERS

Qn.	KVA	Cycle	Voltage	Make	Type
3	3	60	2300/115/230	G.E.	H-M
8	1½	60	4600/120/240	G.E.	H-K
3	3	60	2300/115/230	G.E.	H-N
3	3	60	2300/210/110	West.	S
3	5	60	2300/230/115	West.	S
10	5	60	2300/115/230	G.E.	H-K
3	7½	60	2300/115/230	West.	S
3	7½	60	2300/110/220	G.E.	H-K
3	10	60	2300/115/230	West.	S
6	10	60	2300/115/230	G.E.	H-K
3	20	60	2300/115/230	G.E.	H-K
2	20	60	2200/110/220	Kulhman	
3	15	25	2200/440/220	West.	
6	15	60	2200/110/220	G.E.	H-K
2	30	60	2300/115/230	G.E.	H-K
1	25	25	2200/220/440	Pitts.	Floor
1	37½	25	2300/460/230	West.	SK
2	50	25	2200/220	Wagner	
1	75	60	2300/115/230	G.E.	H-R
2	100	60	2300/230/115	West.	S
1	300	60	4800/120/240	Pitts.	
1	325	60	4800/120/240	Kulhman	
3	200	60	2300/220/440	G.E.	H-SB
1	5000	60 3 ph.	13,200/240	West.	Late

A. C. MOTORS

3 ph. 60 cycle

Qn.	H.P.	Make	Type	Volts	Speed
1	7½	G.E.	KT-180	220/440	1800
2	10	W. B. Brg.	CS-326	220/440	1200
4	10	Al. Ch.	AN	220/440	1200
2	10	West.	CS	220/440	1200
1	15	W. B. Brg.	365	220/440	1200
5	15	Al. Ch.	AN	220/440	1200
1	15	G.E. B. B.	KT	220/440	720
1	20	G.E.	I-K	220/440	600
2	20	Wagner	BP	220/440	1300
1	25	Gen. Elec.	KT	220/440	900
4	25	Al. Ch.	AN	220/440	1200
1	25	Cr. Wh.	Sl. Rg.	220/440	1200
1	25	Lincoln		220/440	1200
2	30	W. E.	KT	220/440	900
3	30	Al. Ch.	AN	220/440	1200
2	30	West.	CS	220/440	720
3	35	G.E.	I-K	220/440	900
1	35	Al. Ch.	AN	220/440	1200
2	40	Gen. Elec.	IK	220/440	1200
1	50	Gen. Elec.	KT-346	220/440	900
2	50	Gen. Elec.	K7337	220/440	1800
3	50	West.	CS	220/440	1800
2	60	Allis Chal.		220/440	1800
1	60	Rob. Meyers	K-209	220/440	1200
3	500	Elec. Mach.	Syn.	23000	514

1—500 KW, 25 to 60 cycle synchronous Frequency Changer, complete with panels.

A. C. MOTORS

3 ph., 25 cycle

Qn.	H.P.	Make	Type	Volts	Speed
18	2	G.E.	KT-731	220/440	750
5	5	Howell	SC-232	220/440	750
14	5	G.E.	KT	220/440	750
5	5	West.	CCL	220/440	750
1	7½	West.	CS	220/440	750
4	7½	G.E. Sl. Rg.	I-M	220/440	750
2	10	West.	CS	220/440	500
1	10	G.E.	I-M	220/440	750
1	10	G.E.	KT	220/440	750
1	15	Howell B.B.	SCR	220/440	500
1	15	G.E.	I	220/440	750
2	15	Gen. Elec.	IK	220/440	750
2	20	Gen. Elec.	IK	220/440	750
3	20	G.E.	KT	220/440	750
1	20	W. Sl. Rg.	CW	220/440	750
2	25	G.E.	I-K	220/440	750
1	25	W. Sl. Rg.	CW	220/440	750
1	25	Burke S. R.	WEV	220/440	750
2	25	Gen. Elec.	KT-337	220/440	750
2	25	WestinghouseCS		220/440	750
2	30	Allis Chal.		220/440	750
1	60	Gen. Elec.	IK	220/440	500
1	100	G.E.	I-K	220/440	750
1	200	West.	CS	220/440	750
1	200	G.E.	I-K	220/440	750
1	3	G.E.	KT-160	220/440	1500
7	5	G.E.	KT	220/440	1500
2	5	G.E. Sl. Rg.	MT-181	220/440	1500
7	5	West.	CS	220/440	1500
1	7½	G.E.	I-K	220/440	1500
1	15	West.	CS	220/440	1500
1	25	Wagner	BP	220/440	1500
1	250	G.E.	I	220/440	1500

MOTOR GENERATOR SETS

1—150 KW Ridgeway Generator, 250 V. D.C. Motor —225 HP, 3/25/440 synchronous, with panels.
1—200 KW, 125 volt, 514 RPM, Motor—300 HP, 3/60/2300 volt, type IK.
1—75 KW 125 volt D.C. Motor—3/25/2200/750 RPM, with A.C. & D.C. Panel.

Send us your inquiries

We have a large selection of 3 phase and 1 phase, 60 cycle welders.

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1512 NIAGARA STREET — **BUFFALO 13, N Y.**

PHONE GR 2715

MOTORS—M. G. SETS—CONTROL

In Stock—Immediate Shipment—Rebuilt & Guaranteed

ADJUSTABLE SPEED MOTORS

Qu.	H.P.	Make	Type	R.P.M.
2	9	G.E.	R.F.-10	400/1600
1	10	Whse.	S.K.	250/1000
1	10	G.E.	R.F.-12	300/1200
3	10	Whse.	SK-90	400/1600
1	10/15	Al. Ch.	E.B.-100	575/1725
3	15	G.E.	R.F.-11	400/1600
1	15	El. Dy.	10-S	450/1350
3	15	G.E.	RF-10	550/1650
1	15	El. Dy.	5-S	600/1200
1	19	Whse.	SK-100-L	600/1200
1	20	G.E.	RF-12	400/1600
1	25	G.E.	C.D.-128	200/800
1	25	G.E.	R.F.-13	400/1200
1	25	Rel.	T-262	500/1500
1	25	G.E.	RF-11	500/1500
2	27½	El. Dy.		450/1350
1	30	G.E.	C.D.M.-105	875/1750
1	32½	Whse.	SK-150	400/1200
1	35	G.E.	RF-14	250/1000
1	35/50	Whse.	SK-160	500/750
1	50	Whse.	SK	250/1000
1	50/65	El. Dy.	30-S	300/1200
1	60	Whse.	SK-131	500/1500
1	100	Rel.	T-1050	400/1200
1	150/185	El. Dy.	75-S	250/500
1	200/250	Rel.	2600-T	400/800

WE CAN SUPPLY WITH THE ABOVE ADJUSTABLE & CONSTANT SPEED MOTORS—Manual—Semi magnetic and manual and fully magnetic AUTOMATIC CONTROL "ENGINEERED TO YOUR SPECIFICATIONS."

SPECIAL: M.G. SET

(1)—Practically NEW 500 KW, Al. Ch. Set, 250-VDC., 900-RPM., 2300-V., 3-Ph., 60-Cy., motor—(3) 333 K.V.A. Whse. dry type Transformers, 13200/2400, synchr. motor control on 13200-V. side of transformers, with complete D.C. panels. We will sell this less transformers with 2300-V. synchr. motor control.

MOTOR GENERATOR SETS

(2)—10 KW, G.E. 2-unit sets, 250-VDC., 1800-RPM., 220 or 440-V., 3-Ph., 60-Cy.
(3)—50 KW, Louis-Allis 250-VDC., 1200-RPM., dir. con. to 75-HP. sq. cg. motors, 220/440/2200-V., 3-Ph., 60-Cy.
(2)—90 KW, General Electric 250-VDC., 135-HP. sq. cg. motors, 220/440-V., 3-Ph., 60-Cy., 1200-RPM., B.B., splash-proof.
(1)—100 KW, Crocker Wheeler 250-VDC., 650-RPM., dir. con. to 150-HP. sq. cg. motor, 220/440/2200-V., 3-Ph., 60-Cy.
(1)—360 KW, G.E. Convertor, 275-VDC., with (3) 120 K.V.A. transf., 1100/208-V., 60-Cy., A.C. & D.C. panels and controls.

SLIP RING MOTORS

CONSTANT DUTY

3-Phase; 60-Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
2	10	G.E.	I.M.	220	1145
1	10	G.E.	I.M.	550	1120
1	20	G.E.	MT-326	220	850
1	25	Al. Ch.	ANY	2200	860
2	25	G.E.	MT-326	2200	860
1	25	Whse.	C.W.	440	1750
1	30	Al. Ch.	ANY	440	900
3	40	G.E.	M.T.	550	560
3*	40	G.E.	I.M.	600	1170
1	40	Al. Ch.	ANY	2200	435
1	50	Al. Ch.	ANY	2200	490
1	60	Whse.	C.W.	2200	1200
2	75	G.E.	M.T.	2200	500
1	75	G.E.	M.T.	2200	600
1	75	G.E.	MT-540	440	900
1	100	G.E.	M.T.	2200	600
1	100	Whse.	C.W.	6900	900
1	100	Whse.	M.W.-766	220	1200
1	150	G.E.	I.M.	550	385
2	150	G.E.	M.T.	2200	720
1	150	Whse.	C.W.	2300	1160
1	200	G.E.	I.M.	2300	514
1	200	Cr. Wh.	127-AG	440	590
1	300	Al. Ch.	ANY	2200	514
1	300	G.E.	I.M.	2200	1200
1	350	Al. Ch.	ANY	2200	514
1	350	G.E.	I.M.	440	580
1**	400	G.E.	M.T.	2200	450
1	400	Al. Ch.	ANY	2300	514
1***	1200	Whse.	C.W.	2300	590

*—40-CYCLE.
**—3-BEARING MOTOR.
***—MILL TYPE WITH MILL CONTROL.

(MANUAL or MAGNETIC CONTROL for starting duty, or reversing and varying speed, can be supplied ENGINEERED TO YOUR SPECIFICATIONS).

SQUIRREL CAGE MOTORS

3-Phase; 60-Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	25	G.E.	F.T.R.	220	575
2	25	G.E.	K.T.	220	900
1	25	Whse.	C.S.	220	1160
1	30	Al. Ch.	ARX	440	575
1	30	Whse.	C.S.	550	900
1	30	G.E.	K.T.	220	860
1	35	Whse.	C.S.	440	1160
1	35	G.E.	I.K.	2200	1200
1	40	F.M.	H	220	860
2	40	Al. Ch.	A.R.	440	860
1	40	F.M.	B	220	1150
1	40	G.E.	K.T.	220	1800
1	40	Whse.	CS-659	2200	1760
1	50	G.E.	I.K.	440	695
4	50	Whse.	C.S.	220	870
1	50	G.E.	K.T.	440	1160
1	50	Ideal	A.T.	440	1750
1	75	G.E.	FTR	440	720
1	75	G.E.	K.T.	440	875
1	75	Al. Ch.	A.R.	440	1750
3	75	Al. Ch.	A.R.	2200	1750
2	100	G.E.	I.K.	2300	695
1	125	Whse.	CS-761	440	1750
3	125	Al. Ch.	A.R.	2200	1750
1	125	Al. Ch.	ARW	2200	1750
1	150	G.E.	I.K.	220	575
1	150	G.E.	I.K.	550	720
1	150	Whse.	C.S.	440	1200
1	200	G.E.	I.K.	2300	490
1	200	Al. Ch.	A.R.	2200	3550
1	250	Whse.	C.S.	2200	1160

"WE CAN SUPPLY WITH ANY OF THE ABOVE THE CONTROL EQUIPMENT ENGINEERED TO YOUR SPECIFICATIONS."

T. B. MAC CABE COMPANY

4312 CLARISSA STREET — **PHILADELPHIA, PENNA.**

important
DIESEL OFFERINGS
immediate delivery

HP	MODEL	KVA	RPM	NEW	HP	MODEL	KVA	RPM	NEW
2—2000	Fairbanks Morse 33	1875	300	99%	3— 165	Murphy ME650	145	1200	95%
8—1600	General Motors 16-278A	1200	720	95%	2— 150	Buckeye Model E	145	400	95%
1— 840	Fairbanks Morse M	565	257	99%	5— 100	International UD18	62.5	1200	new
2— 450	Fairbanks Morse 33E	375	360	95%	1— 100	General Motors 6-71	75	1200	unused
1— 450	Buckeye Model 80	360	600	new	1— 90	Cummins HIS 600	62.5	1200	new
1— 375	McIntosh Seymour	350	360	85%	1— 80	Fairbanks Morse YVA	65	300	85%
1— 365	Ingersoll Rand S	340	600	95%	1— 75	Buckeye Model J	62.5	600	95%
4— 360	Fairbanks Morse YVA	300	257	80%	4— 65	International UD 14	37.5	1200	new
1— 300	Buckeye Model E	250	400	90%	1— 60	Buckeye Model J	50	600	95%
2— 240	Fairbanks Morse YVA	200	257	85%	1— 40	Buckeye Model J	30	600	95%
10— 225	Buckeye Model 80	180	600	new	1— 35	International UD 6	18.7	1200	new
1— 180	Fairbanks Morse YVA	150	257	95%					

Diesel Motors
WE HELP TO LIGHT AND POWER THE WORLD

PORT WASHINGTON, L. I., N. Y. **CORPORATION** TEL: PORT WASHINGTON, 2000

REBUILT POWER EQUIPMENT—READY TO SHIP

M.G. SETS
250 V. D.C.
(Motors 220/440 or 2200 V. 3 ph. 60 cy.)

No.	KW	Make	Speed
2	15	West.	1150
1	20	West.	900
2	40	West.	850
5	50	West.	1200
2	75	Star	1200
2	75	G.E.	600
4	100	Star	1200
1	150	G.E.	1200
1	150	Cr. Wh.	720
1	200	Elliott	1200
1	200	Cr. Wh.	720

Can furnish M.G. Sets at 125 V.D.C. from 5 kw. up to 100 kw. for immediate shipment from stock.

DYNAMOMETER
"Hi-Eff" hydraulic size 35#, model 58S, 3100 rpm., Taylor Mfg. Co.

FREQUENCY CHANGERS
3—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir. con. to 25 HP, 1800 rpm., 220/440 v. 3 ph. 60 cy. motors

COMPRESSORS
1—315 cu. ft. 100 lb. pres. Ingersoll-Rand, Models 315 and 315A portable Air Compressors with 105 HP Waukesha Oil Engines, complete with accessories.
1—630 cu. ft. 100 lbs. pressure Burry Horiz. Compressor.

INDUSTRIAL TRUCKS
5—Automobile type LO-5 Low Lift Electric Trucks capacity 5 ton platform type.
5—New 4 ton Yale & Towne Model YSW Multi-stroke Hand Lift Platform.

INDUCTION HEATING CONVERTER
New Van Norman, type indoor, floor, hi-freq. 32 kw. 220 v. 1 ph. 60 cy. 150 A. enclosed type.

CONVEYOR SYSTEM
Palmer Bee—open chain & trays complete with 5 HP. A.C. motor, Reeves drive, Worm Gear Reducer 90.6 to 1, Unit mt'd on I Beam, platform 42x96", 1928' of 4" open link chain, 727 tray hooks & trolley, curves, rollers, etc.

TESTS STANDS
3—Dennison Eng. Co. portable, hydr. model PHTS-2, 7 GPM constant volume dir. con. 7½ hp. A.C. motors, 3000 lb. pres. capacity.

DEGREASER
Blakeslee, Liquid fully conveyorized, immersion loading and unloading at opposite ends, 13' long 5'3" wide, 10'8" high with ¾ HP. A.C. motor. Conveyor speed 9 rpm., dual vapor control, gage glasses, thermometers, necessary piping and fittings, double strand chain conveyor with cross rods, 25"x20"x3" deep baskets, ¾" Sacro TR-40-3 Water Control, 1½" Sacro SF, 11 Vapor control, storage Tanks, #3 Still, Trans. pump and motors.

DUST COLLECTING UNITS
5—NEW portable, self contained ¼ HP. A.C. Motors, overall Diam. 25"x14½"x23 single inlet, single outlet Fried Air Kool Co.

WINCHES
240—Winch assembly portable engine hoists, swivel hook, 4¾" l, with 1½" opening and 30' of ¼" cable. Hand cranked, double reduction gear with drum 5¾" w. can be used with A.C. or D.C. Motors.

PRESSES
2—Bliss hydro Dynamic marking vertical with 5 HP. A C. motors 80 ton capacity.

FANS or BLOWERS
4—NEW 12000 CFM, Amer. Blower dir. con. 12½ HP. 2 speed A.C. Motors with starters

A.C. GENERATORS, 3 ph. 60 cy.

Kw.	Make	RPM	Voltage
1250	West.	1200	220/440/2300/4000
450	Elec. Machy.	120	220/440/2300/4000
110	Allis Chal.	277	220/440
20	West.	900	120

WELDING AND PLATING SETS
1—Chandeysson 50 KW., 40 V. D.C. 600 rpm., 75 HP. Synchronous Motor 220/440 v. 3 ph. 60 cy., with exciter 100% P.F.
1—Thompson Shell Welder including West. control. 6 electronic tubes, ½ HP. A.C. Motor.
1—Federal special seam welder 200 kva., 220/440 v. 60 cy. 5 DC max. sec. amps. 34000 at ¼ x 33 throat, sec. volts 5.1 10.2 max. air pres. 90 min. water inlet pres. 65# 70 deg. F max.
1—Federal seam welder 150 kva., 220/440 v. 60 cy., .5 DC max. sec. amps. X30,000 at 4 BY-28 throat sec. volts 4-8 max. air pres. 90 deg. min. water inlet pres. 50 lbs. at 70 deg. F. 1 HP. AC. Motor.

CONDENSER OR SYN. MOTOR
500 HP. Elec. Machinery Co. SYN Motor 80% P.F. 120 rpm., 4000/2200/440 or 220 v. with exciter.

POWER PLANTS
5—NEW 1¼ kw. Homelite portable 115 v. 1 ph. 60 cy. 1 cyl. air cooled 2 cycle gas or gasoline.
1—5 kw. Engberg Steam Engine 220 V. D.C.
2—5 kw. Portable Master Elec. 110/220 v. 1 ph. 60 cy. 4 cyl. Wis gas or gasoline engines 80% P.F. pneu. tires.
1—7½ kw. port. Master 4 cyl gas or gasoline 120 v. 1 ph. 60 cy. with pneu. tires and tongue.
2—10 kw. 120/v. Star Generators dir. con. to Hercules DIESEL. 250.
1—25 kw. 120/208 v. 3 ph. 60 cy. 80% P.F. West. Gen. dir. con. to Le Roi Gasoline Engine.
2—30 kw. 125/v. G.E. Generators dir. con. Buda DIESEL.
1—35 kva. Ridgway 220/3/60 dir. Con. Ridgway STEAM engine.
1—125 kva. West 240/480 v. 3 ph. 60 cy. West. dir. con. Erie Ball STEAM Engine.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
5	West.	CS		750
5	West.	CS		750
5	West.	CS		750
5	West.	CS	453	750
5	West.	CS	455	750
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
10	G.E.	KT	312	750
15	G.E.	I Form K		750
15	West.	CS	573	750
20	West.	CS		730
25	West.	CS		730
40	G.E.	I Form K		750
75	G.E.	I Form K		500
100	G.E.	I Form K		750
100	West. (2200 v.)	CS	871 520	1460
125	West. (S.R.)	CW		480
150	G.E.	I Form K		365
150	G.E. (2200 v.)	I Form H		750
150	G.E. (2200 v.)	I Form K		750
150	Allis Ch.	Slip Ring		720
150	G.E. (2200 v.)	KT b.b.	557Y	1470
200	West. (2200 v.)	CS	1013	480
200	G.E. (2200 v.)	I Form K		485
200	G.E. (S.R.)	I Form M		480
200	West. (S.R.)	CW	1011	480

MOTORS
3 phase, 60 cycle—220/440 volts

H.P.	Make	Type	RPM
5	American	Splash Proof BB	1200
5	G.E.	Tri Clad	1750
5	G.E.	I Form K	680
7½	Amer. El	Splash Proof BB	1200
10	Amer. El.	Vertical BB	1200
10	G.E.	KT956	1200
10	G.E.	KT752	1200
15	G.E.	KT312	855
15	West.	CS	1155
20	West.	New BB	1200
20	G.E.	Tri Clad BB	3600
20	West.	New CS365	1800
25	West.	New CS444	900
25	West.	CS	1200
30	West.	New CS445	900
30	West.	CS	1200
40	Cr Wh.		685
40	Lincoln	IM	720
40	G.E.	KT323	1740
50	Al.-Ch.		1800
50	Al. Ch.		1800
50	G.E.		1800
60	Whse. 2200V.	CCL	1200
75	Westghse.	CS	1800
100	Westghse.	CCL	1800
125	Westghse.	CCL	1800
125	Westghse.	CS	1200
150	Westghse	CS	1800
150	G.E.	PK	1200
250	G.E.	I-K	600
300	G.E.	I-K	720
400	G.E.	I-K	900

H.P.	Make	Type	RPM	Ser. No.
50	Al. Ch.		1800	3K28825
60	G.E.	I	1800	292596
60	Whse. 2200V.	CCL	1200	854121
75	Westhgse.	CS	1800	2134671
100	Westghse.	CCL	1800	1043213
125	Westghse.	CCL	1800	765231
125	Westghse.	CS	1200	2318625
150	Westghse	CS	1800	2429726
150	G.E.	PK	1200	
250	G.E.	I-K	600	2246834
300	G.E.	I-K	720	2357743
400	G.E.	I-K	900	2347845

FREQUENCY CHANGERS
All Sizes in Stock. 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 cycle and any other high cycle if desired.

25 CYCLE TRANSFORMERS
3—500 KVA Pennsylvania Transformers 25 Cycle, 1 Phase, 2300 Volts Primary 230/460 Volts Secondary.

60 CYCLE TRANSFORMERS
1—3000 KVA Kuhlman Transformer 60 Cycle, 3 Phase, 14,160 Volts Primary 240 Volts Secondary.

25 CYCLE GEARED MOTORS
3—10 H.P. Westghse., Frame 364 Encl. 1500/378 RPM.
1—15 H.P. Master, Frame 405 Encl., 1450/416 RPM. Exp. Proof.

D.C. CIRCUIT BREAKERS
4—800 Amp. ITE air breakers 2 pole 250 volts complete with overload trips 600/1200 Amp.—mounted on slate panels.

MOTOR GENERATOR SETS
2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP 3 Phase 25 Cycle motors.
1—30 KW Gen. Elec. Generator, Type DLC-203, 125 v. direct connected to 40 HP Gen. Elec. Motor, 3/440/60/720 RPM. with panel board.

SPECIAL
1—150 HP. Fairbanks Morse Ball Bearing Motor. 3/60/440/1800 RPM.
1—75 HP. Fynn-Weischel (Wagner) Synchronous Motor Serial #345781, 3 Phase 60 Cycle 440 Volts, 1200 RPM.
1—75 HP. Fynn Weischel Synchronous Motor 3 Phase 60 Cycle 440 Volts 1200 RPM. with starting control.
1—150 HP Fairbanks Morse Ball Bearing motor 3/60/440/1800 RPM.
1—300 HP. Gen. Elect. Synchronous Motor. Type ATI. 3/60/440/1200 RPM., .8 PF. with direct connected exciter and starting equipment.
1—300 HP. Gen. Elect. Squirrel Cage Motor. Type 115—3/60/440 1200 RPM. with starting equipment.

NEW MOTORS
100—New motors from ½ HP. to 30 HP. in stock. 60 Cycle single and 3 Phase.

ROTARY CONVERTER
1—2000 KW. Westinghouse Booster type Rotary Converter 230 Volt D.C.—3 to 6 Phase, 25 Cycle, 4600 Volt Transformer.

AIR COMPRESSORS
2—5000 CFM Worthington low pressure 45 lb. Compressors with 500 H.P. Gen. Elect. Motors. 3 phase 25 cycle 2300 volts.—Complete.
2—1000 CFM 100 lb. Compressers Driven by 200 HP. Motors.
1—1700 CFM Worthington 2 Stage 100 lb. with motor.

2—5000 CFM Worthington 45# low pressure. Complete with 500 HP. Gen. Elect. Synchronous motors, 3 Ph. 25 Cy. 2300 Volts.

2300 VOLT PRIMARY CONTACTORS
2—150 H.P. Westinghouse AC magnetic controllers 3/60/2300 V.
1—225 H.P. Square D magnetic controller 3/60/2300 V.
2—200 Amp. Schweitzer-Conrad Load Breaks—3 Pole Fused. 3/60/2300 V.

ERIE ELECTRIC CO., INC.
124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

AVAILABLE from STOCK!
A Few Typical Items in Our Current Inventory

SQUIRREL CAGE MOTORS
(NEMA Frame)
220/440 volts, 3 ph., 60 cycle

Qu.	HP	RPM	Make	Type
35	1	1800	A.C., G.E	BB, DP—New
10	2	1200	Al. Ch.	BB, DP—New
35	3	1800	Al. Ch.	BB, DP—New
35	5	1800	A-C, G.E.	BB, DP—New
1	7½	1200	C.W.	TEXP—New
10	7½	1800	L. Allis	OGX—New
2	10	530	Wagner	HS-HT—R&G
1	10	900	G.E.	SB-DP—New
7	10	1800	Al. Ch.	OBB—New
2	10	3600	Al. Ch.	OBB—New
2	10	3600	G.E.	BB, DP—R&G
3	15	1200	G.E.	BB, DP—New
2	15	1200	G.E., Wstg.	HT—New
1	15	3600	G.E.	SB, DP—New
5	20	1200	Al. Ch.	OBB—New
2	25	1200	Al. Ch.	OBB—New
2	30	1800	Al. Ch.	OBB—New
3	50	1200	Al. Ch.	OBB—New
1	50	1800	Al. Ch.	OBB—New
1	125	1800	Al. Ch.	OSB—New

D. C. MOTORS, 230 VOLTS, ADJUSTABLE SPEED, RECONDITIONED AND GUARANTEED
(Except New Where Shown)

1	3	1150 2815	Rel.	14-T, Shunt
2	3/5	600/1800	Wstg.	SK-50
3	3½/5½	500/1500	Wstg.	SK-60
2	3/5	1150 3450	G.E.	Type B, Shunt
2	5/7½	400/1600	Wstg.	SK
5	7½/10	450/1800	Rel.	92-T, Shunt
2	5/7½	500/2000	Rel.	L. A. Shunt
1	10	250/1000	C.C.	Type L
2	10	300 1200	G.E.	RLC-201, Shunt
3	10	500/1500	Rel.	78-TF, Shunt
2	10	550/1650	E.C.K.	Shunt
7	10/15	575/2300	G.E.	DC-85
3	11½	500/1500	Wstg.	SK
3	15/20	400/1200	G.E.	RLC203A, Shunt
1	15/20	600/1800	Rel.	131-T
3	20/25	400/1200	G.E., E-D	
7	20/25	600/2000	G.E.	CD-105
2	20/25	400/1600	G.E.	CD-113
1	30/40	400/1200	G.E.	RLC-204
2	35	500/1500	G.E.	RF13. 2 hrs. 50°
3	40	250/1500	G.E.	CD-1441
2	50	525/1900	G.E.	COM-TE-Dbl. Shaft—New
2	60/75	375/1200	E-D	25-SG
1	125/150	400/1200	Diehl	Comp., K-15
1	150	262/750	G.E.	Frame MPC

SPECIALS
1—250 H.P., new G.E. Synchronous motor, 720 R.P.M., 2200 volts, 3 phase, 60 cycle, mill line torques, 80% P.F.

5—Reliance 40-VS drives, with 40/50 H.P. D.C. motors and complete A.C.-D.C. controls 220/440-3-60.

18—3 KW M-G Sets, 250 volts D.C., 220/440 volts A.C., drip-proof, flat compounded.

We can furnish any A.C. or D.C. control to your specifications up to 1000 H.P., 4160 volts.

ALSO MANY OTHER NEW AND RECONDITIONED A.C., D.C. MOTORS, 1/6 H.P. TO 150 H.P.

THE A-C SUPPLY CO.
Plant & Office Cuyahoga Falls, O. — *P.O. Box 991* AKRON, OHIO — Telephone (Akron) WAlbridge 1174

If You Don't See What You Want
—ask for it!

Quoting the storekeeper's old slogan: "If you don't see what you want—ask for it." Ask the advertisers. They are constantly adding to their stocks and may have acquired just what you need. Or, shall we ask them for you— Write the

Classified Advertising Division

POWER
330 W. 42nd St., New York 18, N. Y.

CONDENSING TURBO GENERATORS

3 Phase 60 Cycle

2000 KW 600 volt 155# G. E. #27000
1500 KW 2300 volt 150# G. E. #15000
1000 KW 2300 volt 150# G. E. 1916
500 KW 240 volt 175# Terry 1923

ENGINE GENERATORS—NON CONDENSING

3 Phase 60 Cycle

320 KW 220 volt 225# 100° S.H. Corliss Cross Compound
250 KW 220/440 volt 160# Corliss

11 KV TRANSFORMERS

Single Phaase 60 Cycle

3—1000 KVA 11000 to 2300
3— 500 KVA 11000 to 440
3— 500 KVA 11000 to 220/440
3— 300 KVA 11000 to 2200
3— 200 KVA 11000 to 2300
3— 150 KVA 11000 to 220/440
3— 125 KVA 11500 to 2300

WATER TUBE BOILERS

70,000#/Hr. B&W Stirling 200# 100° S.H. Pulverizer

30,000#/Hr. B&W Integral Furnace 425#, Pulverizer

750 H. P. Union Iron Works 250#, multiple retort stoker

467 H. P. Edgemoor 200# water walls, multiple retort stoker

250 H. P. B&W 225# 100° S.H. underfeed stoker

SPECIAL

2—Brand New C. E. C. Boilers

2—25,000#/Hr. 200# design pressure, 3 drum bent tube for oil firing

PAUL STEWART & CO., INC.

UNION TRUST BUILDING **CINCINNATI 2, OHIO**

Over 50 Years of Service

QUALITY PLUS POWER— MEANS CHICAGO ELECTRIC EQUIPMENT

MOTOR GENERATOR SETS

KW	Make	A.C.	D.C.
1000	G.E.	2300	600
800	Wtg.	13200	250
600	Cr. Wh.	440	250
500	G.E.	6600	250
350	G.E.	440	250
175	Cr. Wh.	4100	250
150	G.E.	2300	275
90	G.E.	2300	60
75	G.E.	2300	125
75	Wtg.	110	2200
70	G.E.	440	125
65	G.E.	440	125
60	Al. Ch.	2300	110
50	Cr. Wh.	230	240
40	Bogue	440	125/250
40	G.E.	440	125

SQUIRREL CAGE MOTORS

H.P.	Make	Type	Volts	Speed
700	G.E.	IK	440	200
200	Wtg.	CCL	440	1200
150	G.E.	TEFC	440	900
150	G.E.	K	440	1800
125	Howel	SC	440	1200
125	Al. Ch	FS	440	435
100	G.E.	IK	440	600
100	Cent.		440	1800
75	G.E.	KF	440	1200
75	Cent.		440	1800
60	G.E.	K	440	1800
60	Wagner	TEFC	440	3600
50	Wtg.	CS	440	1800
50	G.E.	IK	440	3600
40	G.E.	KT	220	680
40	G.E.	K	440	1800
35	G.E.	IF	440	680
35	Wagner		220	1165

(3 ph. 25 cy.)

H.P.	Make	Type	Volts	Speed
60	Wtg.	CS	440	715
20	Burke	EM	440	750
20	Wtg.	CS	440	715
17	Burke	EM	220	500

MULTI-SPEED A.C. MOTORS

H.P.	Make	Type	Volts	Speed
100	G.E.	K	440	1200/900 600/450
40	Line.		220	850/300
10	Wtg.	CCL	440	1200/900 600/450
7½	G.E.	KT	220	1735/1150 875/575
6	G.E.	KT	440	1200/900
3	U.S.	SCV	220	900/800
3	G.E.	KT	440	1800/1200 900/600
2/1	Al. Ch.	HRT	440	1740/860

D.C. MOTORS

HP	Make	Type	Volts	Speed
430	G.E.	MPC	250	950
300	G.E.	MP	250	425
200	Wtg.	SK	230	1150
100	G.E.	RC	220	2500
50	G.E.	CD	550	1000
45	Wtg.	S	250	650
40	Cr. Wh.	CCM	230	575
40	G.E.	E	220	620
35	Cr. Wh.	CM	220	840
35	N.W.		230	1275
30	Cr. Wh.	CCM	220	450
30	A.C.	Bull.	230	575
25	M. Card		220	1800
25	Wtg.	S	220	850
20	A.C.	E	230	1150
20	Wtg.	SK	230	975

(110 volts)

Hp	Make	Type	Volts	Speed
55	G.E.	DLC	115	1000
45	G.E.	RC	115	800
30	C.W.	CM	115	750
10	A.C.		110	1000

(low voltage)

HP	Make	Type	Volts	Speed
1½	G.E.		60	1800
½	Wtg.	SK	40	1150
¼	Leland	D	32	1725

VARI-SPEED D.C. MOTORS

(230 volts)

HP	Make	Type	Volts	Speed
45	G.E.	TLC	250	1200/2500
40	G.E.	LC	250	825/2060
35	G.E.	C	230	300/900
30	Tri.	JF	230	250/750
30	Wtg.	SA	220	400/1200
25	Wtg.	SK	230	400/1200
20	Rel.	T	230	600/1800

(110 volts)

HP	Make	Type	Volts	Speed
60	G.E.	C	115	500/1500
30	G.E.	E	110	615/1230
20	Roth	RS	115	685/1165
10	G.E.	RC	110	575/1150

SYNCHRONOUS MOTORS

HP	Make	Type	Volts	Speed
500	G.E.	TS	2300	450
450	E.M.		440	240
300	Ideal		2300	300
300	E.M.	BRG	440	900
250	G.E.	TS	2300	600

SLIPRING MOTORS

HP	Make	Type	Volts	Apeed
1200	Wtg.	CW	2200	590
1200	Wtg.	CW	2200	600
1000	Wtg.	HR	2300	360
800	Wtg.	CW	6600	300
750	Wtg.	CW	2300	440
600	G.E.	IL	6600	300
600	F.M.	HV	4800	1800
500	Line.	I	440	900
400	G.E.	MT	2200	450
400	A.C.		4000	1180
350	G.E.	I	440	720
300	Wtg.	CW	440	600
300	G.E.	I	2300	1200
250	G.E.	I	2300	600
250	G.E.	IP	440	450
200	G.E.	IM	2200	600

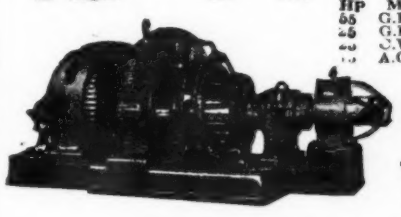
GEARHEAD MOTORS

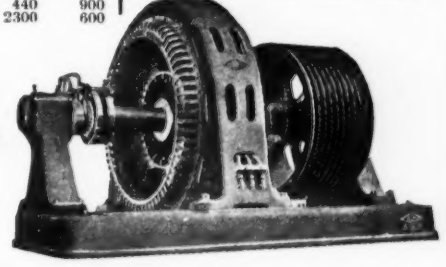
(3 phase)

HP	Make	Type	Volts	Speed
5	G.E.	K	440	98.9
3	Ster.	KFA	440	350
3	G.E.	KT	440	488
2	G.E.	K	440	100
2	Ster.	KFA	440	230

(1 phase)

HP	Make	Type	Volts	Speed
1/8	Master	RA	230	210
1/12		KH	115	172.5





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SWITCHBOARDS CONTROLS PUMPS HOISTS DRIVES

CHICAGO ELECTRIC CO.

1320 W. Cermack Rd. Chicago 8, Ill.

Phone Canal 2900

SLIP RING MOTORS
3-PH., 60 Cy.

HP	Volts	Make	Speed
200	2200/440	G.E.	600
150	2200/440	G.E.	600
125	440/220	G.E.	600
150	440/220	Whse.	1200
125	440/220	G.E. (Hoist)	900
125	440/220	G.E.	900
100	440/220	G.E. (MTC)	900
100	550	G.E.	900
100	440/220	G.E.	600
80	440/220	G.E. (MTC)	900
75	440/220	G.E. (MTC)	600
75	440/220	G.E.	720
60	440/220	G.E.	1200
60	440/220	Cr. Wh.	720
50	2200/440	G.E.	600
50	440/220	G.E.	900
75	550	G.E.	900
40	440/220	G.E.	720

SYNCHRONOUS MOTORS
3-PH., 60 Cy.

HP	Volts	Make	Type	RPM
200	440/220	Whse.	G	1800
300	440/220	G.E.	ATI	600
300	4150/2300	Cr. Wh.	SYN.	900
250	440/220	Whse.	HR	277
200	4150/2300	Whse.	G	1800
200	2200	G.E.	ATI	514
150	4150/2300	G	G	1800
150	440/220	G.E.	ATI	900
150	2200/440	G.E.	TS	600
125	2300	G.E.	TS	327
110	440/220	G.E.	TS	1800
110	440/220	G.E.	TS	257
100	440/220/25 cy	G.E.	TS	375
100	440/220	Whse.	G	1800
90	440/220	G.E.	ATI	1200

AIR COMPRESSOR UNIT

1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm, 110 lbs. ga., motor-driven, complete

CIRCUIT BREAKERS

1—2000 amp., ITE—3 pole—600 v., air circuit breaker

3—New 2500 amp., 600 v., type DA 75, 3 pole, Whse. air circuit breaker

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
300	2200/440	Whse.	CS	600
300	2200/440	Whse.	CS	600
300	440/220	G.E.	KT	1800
250	550	G.E.	IK	450
225	440	G.E.	IK	400
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440	G.E.	IK	360
200	2200/440	Whs.	CS	600
150	440/220	Howell	B. Brg.	1800
125	440	G.E.	KT	600
75	220	G.E.	KT	1200
75	550/220	G.E.	KT	1200
75	440	G.E.	KT	400
60	440/220	Al. Chal.	AR	600
60	440/220	G.E.	KT	1800
50	440/220	G.E.	FTR	900

A. C. GENERATORS

1—225 kva., 720 rpm., 440/220 v., G.E.
1—300 kva., 600 rpm., 440/220 v., G.E.
1—190 kva., 514 rpm., 220/440 v., G.E.
1—150 kva., 900 rpm., 440/220 v., G.E.
1—100 kva., 327 rpm., 2300 v., G.E.
1— 98 kva., 1800 rpm., 440/220 v., G.E.
2— 75 kva., 1800 rpm., 440/220 v., Whse.
2— 75 kva., 1200 rpm., 440/220 v., G.E.
2— 30 kw., 1200 rpm., 440/220 v., G.E.

MOTOR GENERATOR SETS

1—100 kw., 125 v., 1200 rpm. Whse., conn. to 150 hp. 440/220 v., 3 ph. syn. motor.
1—75 kw., 250 v., 1200 rpm. Whse., conn. to 112 hp. 440/220 v., sq. cage motor.
1—25 kw., 440/220 v., 1800 rpm. G.E. alternator conn. to 40 hp. 230 v., DC motor.
1—60 kw., 125 v., 1200 rpm. Whse., conn. to 75 hp. 440/220 v., 60 cy., syn. motor.

TRANSFORMERS
60 Cycle

1—400 kva, Al. Chal., 4000—2300 v., 3 ph. auto.
3—150 kva, Moloney, 11000—2300 v.
3—37½ kva, American, 7200—230/460 v., Pyranol
3—200 kva. Whse. SK, 2200-244/488.
9— 25 kva. Whse., 440-115/230 v. dry new.
1—150 kva. Whse. SK, 13200-125/215 v. 3 ph.
3— 50 kva. G.E., DRY, 460-115/230 v.
6— 25 kva. G.E. DRY, 2400-120/240 v.

TUBBO-GENERATOR

Generator, 125 kva, 1200 rpm, 440/220 v., Whse., dir. conn. by reduction gear to Turbine, 100 kw, 7380 rpm, non-condensing, 150/200 lbs. ga. pr., complete with d.r. conn. exciter and switchboard: practically new condition, never used.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

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TURBINE-GENERATORS

2—General Electric 2250-KVA, 3-phase, 60-cycle, 2300 volts, 3600 RPM Generator, direct-connected to General Electric 1800-KW, 3600-RPM, 10-Stage, Condensing Turbine, 410 lbs. throttle pressure, 28 to 28.5 inch vacuum. Complete with Surface Condenser and Condenser Auxiliaries. New — 1943. Used Approximately 3200 Hours and Like New.

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2526 GUARDIAN BLDG. DETROIT 26, MICH.

CAdillac 1856-1857

FOR SALE

750 HP Fulton diesel 4 cylinder, 4 cycle, 500 KW 3 phase, 60 cycle, 440 volt generator. Complete.

750 KW GE condensing turbine 3 stage, 3600 RPM 3 phase, 60 cycle, 2300 volt, surface condenser.

25 KW International UD-14 portable diesel generator set, 220 volts. Like new.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St., St. Louis 1, Mo.

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ARCHER & BALDWIN, INC.

(Inc. 1917)

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1—250 KVA G. E. 60 cy. 1 ph. 7800—460
1—100 KVA G. E. 3 ph. 60 cy. 2300—460
12— 75 KVA New Atlantic, 60 cy., 1 ph. 2400—240/120
10—100 KVA New Atlantic, 60 cy., 1 ph. 2400—240/120
2—150 KVA. 60 cy. 1 ph. 4160—240/120

ATLANTIC TRANSFORMER CO.
TRANSFORMER SPECIALTIES

5143 N. 2nd St. Philadelphia, Pa.

600 KW DIRECT CURRENT GENERAL MOTORS Diesel Generating Set

Westinghouse Generator 500 Volt, 720 RPM Electric Start

UNUSED * Ready to Ship

ALJOHN DIESEL CO., INC.

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SINCE 1912

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SIX—400 H. P.—225 LB. STEEL ENCASED CROSS DRUM TYPE —WATER TUBE BOILERS—OIL FIRED.

TWO—400 H. P.—300 LB. WATER TUBE, CROSS DRUM TYPE BOILERS. ASME.

ONE—165 H. P.—125 LB. ECONOMIC TYPE BOILER, COAL FIRED. ASME.

ALSO STEAM TURBINES, DIESEL SETS, MOTORS AND MOTOR GENERATORS, SWITCHES, ETC.

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AMERICAN ROTARY
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Rebuilt Pumps in Centrifugals

STEAM & HIGH PRESSURE HYDRAULIC

C & S MACHINERY CO.

715 Howard Street St. Louis 6, Mo.
Garfield 4290

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25 cy. 60 cy. D.C.

ALL VOLTAGES 1-1500 H.P.

NEW and REBUILT
BOUGHT and SOLD

ELECTRIC EQUIPMENT CO.
ROCHESTER 1, N. Y.

TURBO GENERATORS and BOILERS

1000 KW., 3 phase, 60 cycle, 480 volt, 3600 RPM., General Electric, rigid frame type non-condensing, 160 lbs. and 25 lbs. back pressure.
750 KW., 3 phase, 60 cycle, 2300 volt, 3600 RPM., Gen. Elec. rigid frame type, non-condensing 125 lbs. and 5-10 lbs. back pressure.

750 KW., General Electric rigid frame type 3600 RPM., 150 lbs. extraction 10 lbs. Generator can be wound for 220, 440, 550 or 2300 volts.

SMALL SIZES IN STOCK

6—400-500 HP steel encased water tube Heine boilers. Cross drum type.

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Power Plant Equipment Company

8403 Hegerman St. Phila. 36, Pa.

STEEL TANKS in STOCK at N. Y. - New Orleans & Los Angeles

60 New 42,000 Gal. (1000 bbl.) Bolted Vert.
366 New 4200 Gal. (100 bbl.) Bolted Vert.
L. M. STANHOPE Rosemont, Penna.

APPLICATION ENGINEERS

45 KW M.G. Set 2200 AC 250 DC
100 KW M.G. Set 220/440 AC 125/250 DC
285 KW 240 volt Chuse Uniflow engine set
200 KW 480 volt Ridgway engine set.
2500 KW 2300 volt G.E. Cond Turbine set
200 KW 1800 rpm 440 volt TEFC Motor

HOWARD B. JOHNSON & ASSOCIATES
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450# 720° F.TT. GENERAL ELECTRIC TURBO-GENERATORS Immediate Delivery

WITH NEW (Never Used) SURFACE CONDENSERS And NEW Condenser Auxiliaries

1—5000-KVA. General Electric, 450#-psi., 720° F.TT., 3/60/2300-Volts

2—2850-KVA. General Electric, 450#-psi., 720° F.TT., 3/60/480-Volts

Slightly Used. For Service Guaranteed Same as New Machines

Brand NEW (Never Used) SURFACE CONDENSERS and NEW CONDENSER AUXILIARIES

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ELECTRIC MOTORS
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CHEMICAL and INDUSTRIAL PUMPS

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TURBINE STEAM — ROTARY POWER
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IRON—BRONZE—STAINLESS

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Check Your Requirements with our Engineering Department.

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155 MULBERRY STREET, Newark, N. J.
MItchell 2-5478

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New 1942-1944

1000 KW, 230 Volts DC, *GENERAL ELECTRIC* 720 RPM, motor synchronous, 2300 Volts, 3 phase, 60 cycle (one Unit)

1000 KW, 550 Volts DC, *ALLIS CHALMERS,* 720 RPM, motor synchronous, 2300 Volts, 3 phase, 60 cycle (6 units)

600 KW, 500 Volts DC, *ELLIOTT,* 720 RPM, motor synchronous, 2300 volts, 3 phase, 60 cycle (4 Units)

300 KW, 125/250 Volts DC, *WESTINGHOUSE,* 1200 RPM, Generators only. Will supply suitable motors (4 Units)

100 KW, *ELECTRIC PRODUCTS CO.* AC Generator, 3 phase, 60 cycle, 440 Volts, 1200 RPM. Motor—*RELIANCE* 150 HP, 230 Volts DC, Complete switchgear (2 Units)

Immediately available.

A. G. SCHOONMAKER COMPANY, INC.
50 CHURCH STREET, NEW YORK

Established 1898 **Worth 2-7225**

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120,000 CFM, Type "K" Buffalo Forge Mfgr. Fans deliver 120,000 CFM @ ½" S.P., 314 RPM at 110°F.

IRON & STEEL PRODUCTS, INC.
13488 S. Brainard Ave., Chicago 33, Ill.
"ANYTHING containing IRON or STEEL"

Steam Engine with alternator direct connected 100 K.W. 220 volt 3 phase, 60 cycle.

2 Babcock & Wilcox straight tube boilers 150 and 200 H.P.

Motors, 3 Phase 60 cycle 220 Volt, 1140 and 1750 RPM. All sizes, ½ to 30 H.P. New and used.

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75, 100, 150, 350, 400 HP Slip Ring Motors
50, 60, 100, 200, 300 HP Sq. Cage Motors
750 KVA 2300/440 V. Gen. D/C Unaflow Eng.
75, 100, 200 HP Scotch Marine Boilers
180 HP (3) ASME 150# HRT Boilers
Distillery Machinery—Vats, Mills, Stills, Copper Tanks, Cookers, Motors, Pumps, Etc.
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6719 Etzel Ave., St. Louis 14, Mo.

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2—400 H.P. Springfield sectional header, oil burners, N. J. & ASME stamping.
2—25,000# B & W Stirling's, unit pulverizers National Board Stamping.
Various other sizes and types
H. P. BREARLEY
3423-91st Street, Jackson Heights, N. Y.

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SINGLE PHASE—OISC

2—3 KVA Whse. 6000 to 115/230 (new)
3—50 KVA G. E. 33000 to 2300 V.
5—100 KVA G. E. 22000 to 220/110 V.
6—200 KVA Whse. 11000 to 440/220 V.
2—400 KVA Al. Ch. 66000/2300/4000 Y.
6—500 KVA G. E. 13200 to 575 V.
6—500 KVA Whse. 24000 to 220/110 V.
3—667 KVA Pack. 11000/22000 to 440 V.
3—667 KVA G. E. 33000 to 440/220 V.
2—1200 KVA Whse. 66000/2300/4000 Y.
2—2000 KVA Whse. 66000 to 2200 V.
3—2000 KVA G. E. 13200/26000 to 2300 V.
3—2000 KVA Whse. 33000 to 11000 V.
3—2000 KVA G. E. 33000 to 13200/6600 V.
7—4000 KVA G. E. 18950/27600 Y to 13800/6900/4160 V.

THREE PHASE

3—450 KVA G. E. 66000 Y to 440 V.
6—650 KVA G. E. 13200 to 2300 V.
1—1200 KVA Whse. 6600 Y to 2300 V.
2—1500 KVA G. E. 13200 to 440 V.
3—1800 KVA G. E. 13200 to 550 V.
1—3000 KVA G. E. 11600 to 440 V.
1—15000 KVA Pitts. 27880 to 4560Y. V.

WATER COOLED-SINGLE PHASE

4—3333 KVA G. E. 25/60 Cy. 6000 to 4000/6925Y 8000/13850
3—1500 KVA Al. Ch. 33000 to 13200/6600 V.
7—750 KVA Whse. 33000 to 2200 V.
7—675 KVA Whse. 33000 to 2200 V.

PYRANOL

1—3000 KVA Penna. 25 Cy. 13800 to 480 V. 3 Ph.
10—37½ KVA Penna. 440 V. to 220 V 60 cy. 3 ph.

NETWORK TRANSFORMERS

19—150 KVA G. E. type Ht, late type, oil or pyranol cooled, 3 ph., 60 cy., 27060/125/216Y Vault or submersible type; attached to each transformer is G. E. automatic heavy duty network protector type MG-6 and heavy duty primary switch; complete with all accessories.
8—200 KVA G. E. Ditto

STATION-TYPE REGULATORS

4—63 KW indoor type Westinghouse constant current regulators, Type R.S., Prim 2200 V., 60 cy., Amp. 6.6 & 7.5 Serial Number 582020

PHILADELPHIA TRANSFORMER CO.
2829 Cedar St. Phila. 34, Pa.

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1—7½ H.P., G.E. MT 956, 1200 RPM., SB 220V.
1—7½ H.P., G.E. MT 952, 1160 RPM. SB 440V.
1—7½ H.P., G.E. MT 760, 1800 RPM. SB 220V.
1—20 H.P., G.E. MT 512, 1200 RPM. SB 220V.
1—30 H.P., Westinghouse, CI 900 RPM. SB 440V. Fr. 638.
1—50 KW Westinghouse MG set, 125V. 1150 RPM., compound wound, complete with charging panels.
1—50 H.P. G.E. MT 346Y, 690 RPM., 220V. SB., bare—will not connect to 440V. Will connect 550V.

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NEW ILG MARINE BLOWER FANS
24"—6250 C.F.M. 33"—10000 C.F.M.
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Axial Flow—Propeller Type Driven by 230 volt DC Motors.
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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.
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MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

LARGE STOCK OF A.C. and D.C. MOTORS!

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
1	3	1750	440*	West.	CW-232C
1	5	580	220*	G.E.	HI-9
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220*	G.E.	MT-522
2	10	1140	440*	West.	HF-7A
2	10	570	220*	G.E.	HI-11
3	11‡	810	550	G.E.	ITC-5008
1	15‡	900	440*	G.E.	MTC-5302
2	15	570	220*	West.	CW-646
1	18	680	440*	West.	MW-316
1	25	1130	550	G.E.	MT-323
2	25	850	220*	Wagner	BR
2	25	720	440*	Wagner	22VBR
1	30	865	440*	West.	CW-646
1	30	850	440*	G.E.	MT-332
1	30	675	440*	G.E.	MT-336
2	35	600	440*	F-M	HV-H16A
2	40	865	2200	Al.-Ch.	ARY-223C
1	40	560	440*	G.E.	MT-346
1	50	860	440*	West.	HF-12A
5	52‡	550	220*	G.E.	IQC-5013***
1	60	685	440*	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW
1	75	720	550	G.E.	MT-556
1	80‡	575	440*	G.E.	MTC-5352
1	100	1760	220*	Al.-Ch.	ARY-223BS
2	125	430	440*	G.E.	IL-16
2	150	1750	440*	G.E.	MTP-549
1	150	720	2200	G.E.	I-M
1	150	385	550	G.E.	IM-17
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
3	250 (new)	360	440	West.	CW-20-53-15
3	300	900	440*	G.E.	IM-17
1	300	514	550	G.E.	IM-17A
1	400	505	550	West.	CW
1	700	720	2300/4000	West.	CU

*Can be furnished for either 220 or 440 volts but not both voltages.
‡Intermittent rating.

230 VOLT CONSTANT SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
22	2	850	West.	SK-20
20	3	1150	West.	SK-20
10	3	850	Reliance	T-23T
25	3½	850	West.	SK-30
3	7½	1750/1310	West.	SK-43
2	7½	1150	G.E.	CDM-66
2	7½	875/1750	West.	SK-63L
3	7½	850	G.E.	CD-75
5 (new)	10	1150	Al.-Ch.	EB-80
1	10	850	West.	SK-83
10 (new)	12½	600	West.	SK-93
5	15	825	West.	SK-90
3	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-90
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	750	G.E.	RC
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	650	G.E.	RC-16
2	60	1750/1310	West.	SK-143
3	75	850	West.	SK-160
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
1	15	3485	220*	Reliance	AA-B3247
2	20	1160	440*	West.	CS-554
1	25	1140	2200	West.	CCI
1	25	705	440*	West.	CS-W504-TEFC
1	25	690	440*	G.E.	KT-336
1	30	870	220*	West.	CS-646
1	30	1160	440*	West.	CS-644
1	40	1200	440*	G.E.	KT-332
2	40	900	2200	G E	FTR-536
1	40	900	440*	G.E.	KT-536
1	50	850	220*	West.	CCL
2	60	900	440*	G.E.	KT-346
1	75	1750	2200	West.	CS-761
1	75	900	2200	G.E.	KT-352
1	100	1765	2200	West.	CS-765A
2	100	870	440*	G.E.	KT-356
1	100	690	220*	West.	C.
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	390	2200	G.E.	I-17-FR
2	150	1800	440*	Howel	N-684
3	150	1175	2300‡	G.E.	KTP-557
2	200	1750	440*	West.	CS-855S
4	200	580	550‡	G.E.	KT-566S
4	350	1750	2300	G.E.	K-559
1	500	1200	440*	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

*Can be furnished either 220 or 440 volts, but not both voltages. ‡Reconnectable for 440 volts.

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
10	1½/2	500/200	G.E.	CD-65
1	2	225/900	Reliance	78T
6	5/7½	600/1800	G.E.	RA-30
1	12½	280/840	West.	SK-130
10 (new)	12½	600	West.	SK-93
1	15	600/1800	Reliance	T-131T
1	15/20	500/1500	G.E.	CD-95
1	20	400/1600	G.E.	RF-12
1	23/29	300/1200	G.E.	RF-13
1	25	500/1600	Reliance	T-230T
1	30	400/1200	West.	SK-163
1	35	500/1500	West.	SK-143
3	40/50	400/1600	Al.-Ch.	EB-147
3	40/50	400/1600	Reliance	T-383T
1	75	500/1500	Cr-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	175	230/750	West.	SK-220
2	375	350/500	G.E.	MPC

CRANE, MILL TYPE, 230 V. D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
2 (115 v.)	3½	700	G.E.	CO-1803
2	5½	760	West.	MCB-20
1 (new)	10	650	G.E.	MD-403-BE
2	10	690	West.	K-4
1	13	575	G.E.	CO-1806
1	15	830	West.	K-5
1	20	515	West.	K-6
3	25	590	Diehl	TE
2	27	490	West.	MC-40
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50	750	G.E.	CO-1829A
1	50	600	West.	CK-9
5 (new)	50	525	G.E.	COM-1830AE
1	59	470	G.E.	CO-2007
2 (new)	60	550	G.E.	COM-1831AE
1	70	440	West.	MC-70

VARIABLE VOLTAGE DRIVES
40 HP. Reliance, Variable Voltage Drives, each Consisting of:
1—40 KW. 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP. 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

NEW A. C. MOTORS IN STOCK
SQUIRREL CAGE, BALL BEARING 1800 RPM, 3 Ph., 60 Cy., 220/440 V.

Qn.	HP	Make	Type
15	1	G.E.	K-203
15	2	G.E.	K-224
15	3	G.E.	K-225
15	5	G.E.	K-254
10	7½	Al.-Ch.	AR-284
7	7½	G.E.	K-284
6	10	G.E.	K-324
2	20	G.E.	K-364

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

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"Export Orders Carefully Executed"

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3-2000 KVA Each Transformer Single Phase High Tension
1400/2200 KW Turbo-Generator, non-condensing, Excellent Condition

1—90,000# Boilers 575#
2—60000# Boilers 250#
4—1000 H.P. Heine Boilers 225#
2— 825 H.P. B & W Sterling Boilers 200#
2— 600 H.P. Edge Moor 200# Stokers
Smaller Boilers and Tire Tube Boiler salso
2—3000 K.W. Turbos @ 350#

2—2500 K.W. G.E. Co., Turbo-Generator Condensing
2—2000 K.W. G E. Co., Turbo-Generator Condensing
1—6500 K.W. G.E. Co., Turbo-Generator Condensing
1—2000 K.W. W.E. & M. Co., Turbo-Generator Con.
2—1000 K.W. G.E. Co., Turbo-Generator Condensing
2— 750 K.W. G.E. Co., Turbo-Generator Condensing
Several 500 KWs. & Smaller Units

Non-Conducting Turbos—300—500—750—and 1,000 K. W. & Larger

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MOTOR GENERATOR SETS
ALTERNATORS, ALL FREQUENCIES
TRANSFORMERS, LARGE STOCK
D. C. GENERATORS, ALL VOLTAGES
CONTROL EQUIPMENT

ALL SIZES
VOLTAGE AND CYCLES

3 ph. 60 cy. A.C. Motors
3 ph. 25 cy. Motors
125 Volts D. C. Motors
230 Volts D.C. Motors
550 Volts D.C. Motors

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Put all idle equipment to work. Send your list for prompt action. **WRITE OR WIRE YOUR INQUIRIES**

SYNCHRONOUS ROTARY CONVERTERS

Qu.	KW	Make	Speed	D.C.V.
1	750	G.E.	1200	600
1	500	Whse.	1200	600
1	400	G.E.	1200	275
1	300	Whse.	1200	600
1	175	Whse.	1200	275
1	125	G.E.	1200	275

TRANSFORMERS

1—200 KVA Kuhlman, Cont. Duty, Auto. 3300-2300/3/60.
3—37½ KVA Pitts. Cont. Duty, Auto. 6900-2300/1150.

MOTORS

1—80 HP. 1200 RPM, Cr. Wh. 220/440/3/60 Ind.
1—75 HP. 1800 RPM. U. S. Line Start 220/440/31 60 Ind. B.B.
1—65 HP. 1200 RPM, G. E. type KT. 220/440/3/60 Ind.
1—40 HP. 900 RPM, Whse. type CW, 440/3/60 Slip Ring.
5—5 HP. 2200 RPM. Reliance Ex. Proof, 230 V. D. C.
Several Whse. type SK, 230 V. D.C.
5, 7½, 10 and 15 HP. New TEFC and standard open ball bearing AC motors available. Across line and reduced voltage starters.

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Complete with Control Equipment

3—150 KW, 900 RPM, 250V, DC. to 225 HP 2300V. A.C. Syn.
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Complete with Auxiliaries and Control Equipment.

1—3650 KVA 3600 RPM, 2300/3/60, Whse.
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FOR SALE—

1—16 x 21 Chuse Non-Condensing 150 KW generating unit
1—18 x 21 Chuse Non-Condensing 210 KVA generating unit
1—25 x 28 Chuse Non-Condensing 450 KVA generating unit
1—450 HP Bruce-McBeth late type Natural Gas Engine
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50 HP. 900 RPM. 3/60/220 V. Crocker Wheeler
50 HP. 600 RPM. 3/60/2200 V. General Elec. MT
60 HP. 1750 RPM. 3/60/2200 V. Allis Chalmers

NEW MOTORS

50 HP. 3600 RPM. 3/60/220-440 Fairbanks Morse XP
50 HP. 1800 RPM. 3/60/220-440 Reliance Ball Brg.
50 HP. 1200 RPM. 3/60/220-440 Reliance Ball Brg.
60 HP. 3600 RPM. 3/60/220-440 Crocker Wheeler Ball Bearing
75 HP. 1200 RPM. 3/60/220 General Elec. BB
100 HP. 3600 RPM. 3/60/220 Fairbanks Morse BB
100 HP. 1800 RPM. 3/60/220 General Elec. BB
100 HP. 1200 RPM. 3/60/440 General Elec. BB

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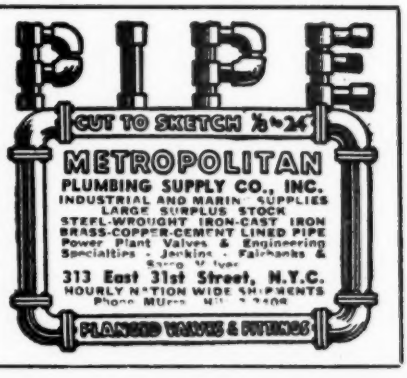
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2—Buda 30-KW, 80% P.F. 127/220V, 3 phase, 60 cycle, slightly used

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SPECIAL OFFERING

3—4300 Gal. Morris Centrifugal pumps, single stage, 240 ft. head, 1750 RPM, 14 in. sus., 12 in. dis., type TS-12H, direct connected to 300 HP Crocker Wheeler squirrel cage motor, 3 ph., 60 cy., 2200 V. New 1940.

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NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

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D-880C Caterpillar Engine
4 cyl. 5¾" bore 8" stroke
Speed 550 to 1000 v.p.m.
80 HP continuous rating at 1000 v.p.m.

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Auxiliaries include: 3 *BRINE CIRCULATING PUMPS* duplex steam type; 1 *WATER CIRCULATING PUMP*; 1 *AIR PUMP FOR CONDENSER*.

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100 Kw, 250 Volt, 900 Speed Comp. Interpole Reliance D.C. Generator, Direct coupled to 150 H.P., 900 Speed, 3 ph-60 cy. motor—field rheostat only.
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3—333 KVA-4600/460 Volt single phase transformers

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2-200 KW MOTOR GENERATOR SETS

3/60/2300 AC to 275 Volts DC, complete with starting equipment.

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D.C. MOTOR GENERATOR SETS TO 75 KW • HIGH CYCLE GENERATORS
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1— 80 HP Cyclotherm Steam Generator 125# (New)
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1—750 KW Westinghouse Turbo Generator, 250# pressure, 100° superheat, 2300 volts, all auxiliaries, recently rebuilt.
1—6250 KW General Electric, 1800 RPM, Condensing, all auxiliaries.
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1—360 KW Chicago Pneumatic—480 Volts—New.
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5—100 KW General Motors Diesel Engine Generator Sets, 110-240, D.C. new 1942.
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1—27"x36" Skinner Uniflow, direct connected to 562 KVA AC Generator, complete.
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1—375 KVA Harrisburg Uniflow Engine Generator.
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1—450 KW Skinner Uniflow Engine Generator, 2300 volts, 14 years old.
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SPECIAL OFFERING:

1—850 HP Casey Hedges Water Tube Boiler, 225# pressure, complete with all Trim Copes Regulator, Combustion Engineering Stoker. Boiler new 1932. Available for immediate shipment.

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New Condenser Tubes

50 Tons ⅝" O. D. 18 gauge, Cupro Nickel, 11'8" long
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K.V.A. output	1.250	R.P.M.	3600
K. W. output	1.	Cont. Duty Ph.	Single
P. F.	.80	Cycles	60
Volts input	115. D. C.	Volts output	120. A. C.
Amps. input	.14	Amps. output	10.4

Length 26"; width 12⅞"; height 13".
Compound accumulative A. C. and D. C. fields. Centrifugal starter. Splashproof covered, frequency adjustable to load, plus or minus five cycles. PRICE $87.50.
Identical machine, but 230 volts D.C. input $125.00.

Prices f.o.b. Tuckahoe, New York
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10—General Motors Diesels, marine type, 900 horsepower, 744 RPM, 12 cylinder, electric starting.

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All Engines Complete With Auxiliaries — All In Excellent Condition.

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CATERPILLAR MODEL D 13000 DIESEL ELECTRIC SET—66E, G.E. Generator—KVA 92, KW 74, HP 138 USED 178 HRS. Complete with Battery chargers, Switchboards & Transformers.

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2—Engine driven generators, 2300 v., 325 KVA Allis-Chalmers and 460 KW G.E. Details on request.

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1—750 KW, 250 volt D.C. Generator, direct connected, single bearing.

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For synchronous motors 200 H.P. and 250 H.P. 3-60-4150

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Two 9' x 11' Harrington Chain Crate Stokers, capable of carrying two 600 horsepower boilers, complete with forced draft fan and vertical reciprocating engine 8 x 8. Completely dismantled and ready for immediate shipment.

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Complete Automatic Grinnell Simplex

SPRINKLER SYSTEM

Including 4500 gal. tank, 100 lb. working pressure, 5 h.p. compressor, several hundred Type B-31 Grinnell sprinkler heads, and associated pipe. Near new.

Ideal for factory, school, or other building in country using well water supply.

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NEW—Immediate Delivery
SCOTCH TYPE BOILER

With North American Burner for light or heavy oil, or gas.
Boiler is ASME code 125 lbs., design, 500 sq. ft. of heating surface and will develop up to 80 Horsepower.

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100,000 GAL. CAP.

STEEL ELEVATED WATER TANK

ON 90 FT. STEEL TOWER

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ALL SIZES, VOLTAGE AND CYCLES

MOTOR GENERATOR SETS
ALTERNATORS, ALL FREQUENCIES
TRANSFORMERS, LARGE STOCK
D. C. GENERATORS, ALL VOLTAGES
CONTROL EQUIPMENT

3 ph. 60 cy. A.C. Motors
3 ph. 25 cy. Motors
125 Volts D.C. Motors
230 Volts D.C. Motors
550 Volts D.C. Motors

WRITE OR WIRE YOUR INQUIRIES

BERGER BROTHERS Electric Motors, Inc., 395 STATE ST., ROCHESTER 4, NEW YORK

PUT ALL IDLE EQUIPMENT TO WORK. SEND YOUR LIST FOR PROMPT ACTION.

TRANSFORMERS WANTED

usable or burnt-out

IN - STOCK

1—1000 KVA -GE Single Ph.
2—750 KVA-Pittsburgh—Single Ph.
1—30 KVA-GE Constant Current
1—600 KVA Westg. 3 ph.

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Poplar 5-0553

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PLUMBING SUPPLY CO., INC.
Power Plant Valves and Engineering Specialties for Oil, Steam, Gas, Air, Liquids and Chemicals.
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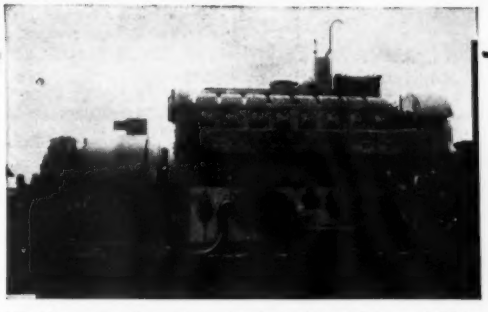

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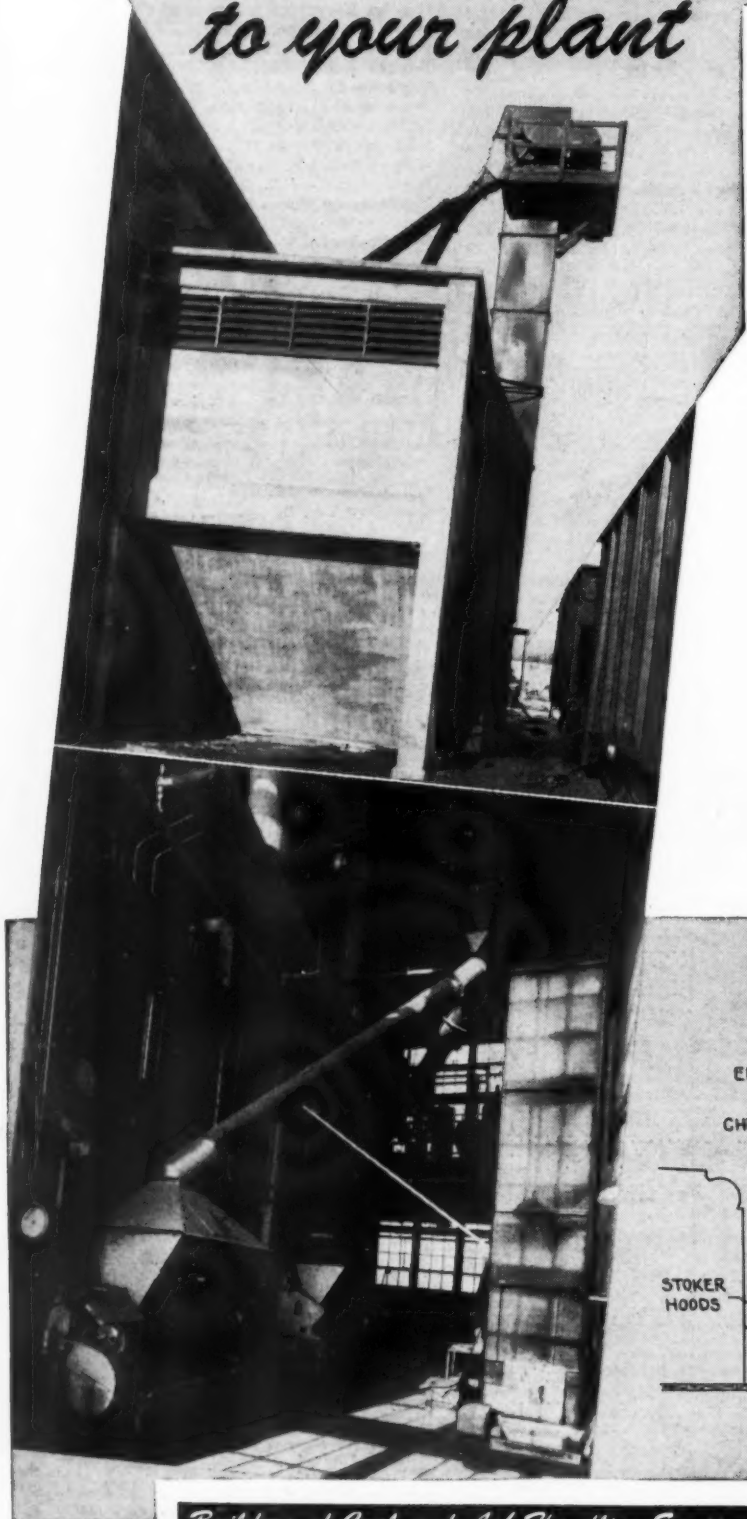
to your plant



• Here is a typical example of how the Fairfield system of coal handling met this boiler plant's needs.

In this instance the coal is transported from the track hopper by a reciprocating feeder to a bucket elevator and through a bifurcated chute to the coal bunker.

A flight feeder under the bunker delivers coal to another elevator inside boiler house. The coal is fed through chutes to the stokers which have large extension hoppers.

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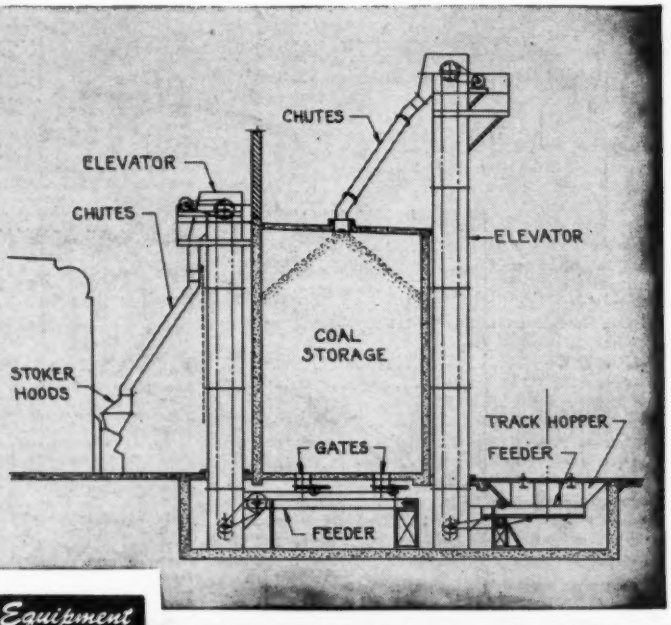
Why not give us an opportunity to show you how to cut your coal and ash handling costs. Write for complete data.



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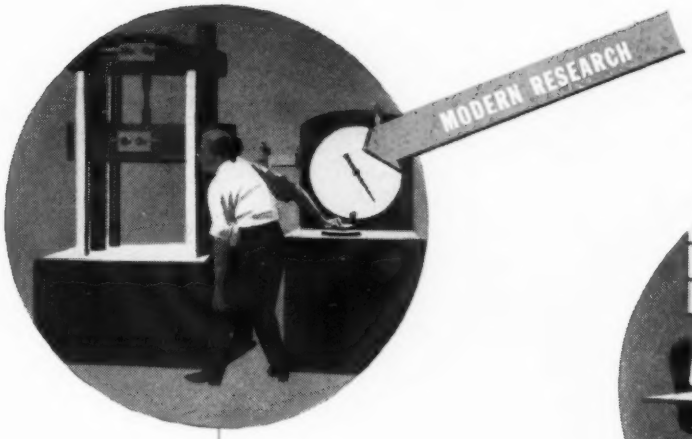

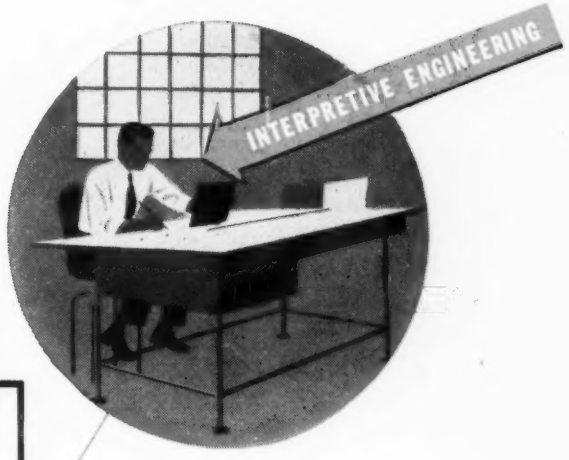

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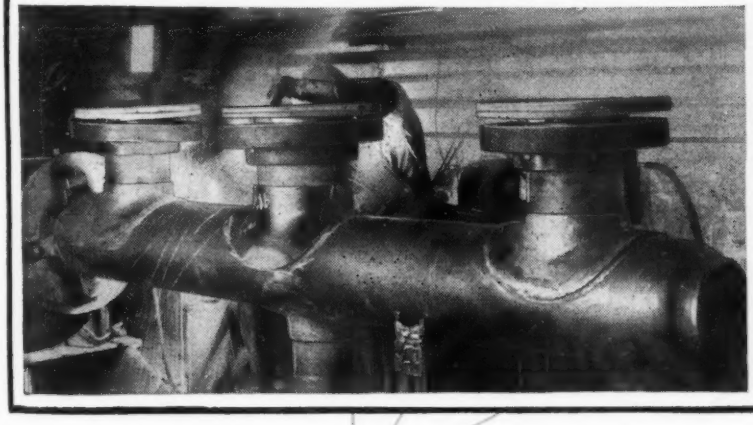

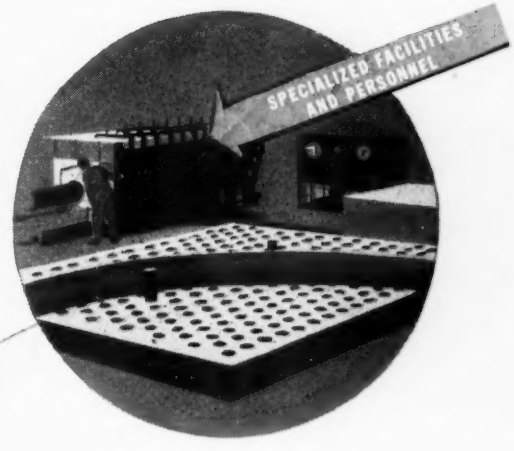

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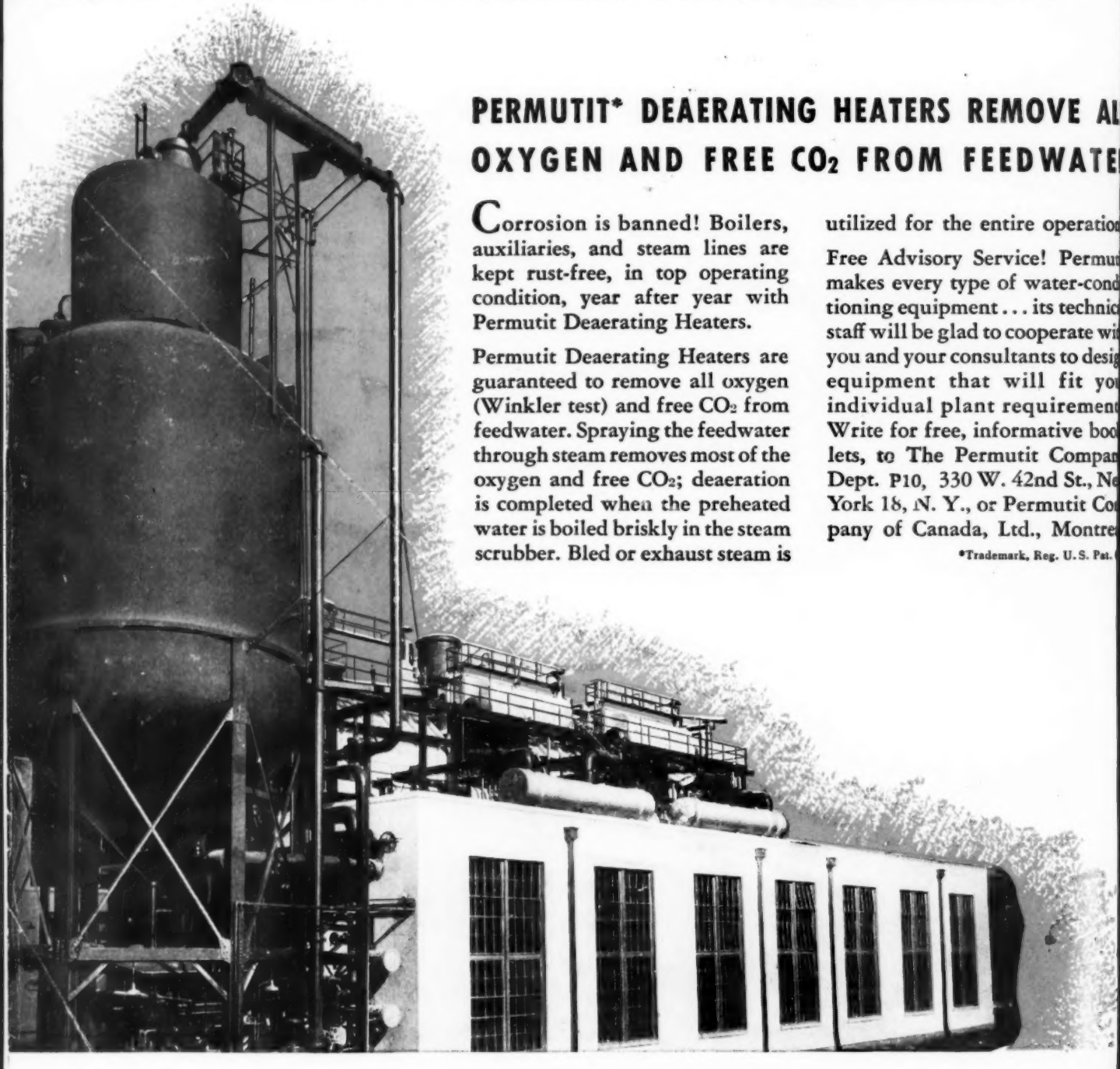

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